

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ELEG 3301- Network Theory II
FALL 2021**

I. COURSE DESCRIPTION IN ABET FORMAT

II ASSESSMENT RESULTS FOR CURRENT AND PAST PERIODS

Program Outcomes Assessed in Course

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II. EXAM

Summary of Topics covered by Exam

Original Exam Questions & Master Solution/grading scheme used

(Summary of topics can be a separate page or include on the assignment itself)

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

III. COMPUTER ASSIGNMENT

Summary of Topics covered by Computer Assignment

Original Homework Questions & Master Solution/grading scheme used

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

IV. PROJECT

Summary of Topics Covered by Project

Project Problem Statement and Grading Scheme

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

Course Description in ABET Format

1. Course number and name:	ELEG 3301 NETWORK THEORY II
2. Credits and contact hours:	3 credit hours; 3 contact hours
3. Instructor's or course coordinator's name:	Dr. John O. Attia
4. Text book: Title:	Fundamental of Electric Circuits,
Author:	C. K. Alexander and M.N.O. Sadiku
Publisher, Year & Edition:	5 th Edition, 2013, McGraw Hill
a. Other Supplemental material	None
5. Specific course information	
a. Brief description of the content of the course (catalog description)	ELEG 3301 Network Theory II. (3-0) Credit 3 semester hours. Continuation of transient and sinusoidal analysis. Study of average and RMS power, poly-phase circuits, complex frequency, frequency response, and magnetic circuits.
b. Prerequisites or Co-requisites	ELEG 2305 Network Theory I No co-requisites
c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	Required
6. Specific goals for the course	Students will be able to :
a. Specific outcomes of instruction (e.g. the student will be able to explain the significance of current research about a particular topic.)	(1) Be able to able to analyze electric circuits in the frequency domain. (2) Be conversant with different types of filters and their characteristics. (3) Be able to analyze three phase circuits. (4) Be able to understand the operational characteristics of transformers and two port networks. (5) Be able to design, construct, and test electric circuit that satisfies multiple constraints. (6) Be able to use PSPICE or MATLAB to solve electric circuit problems.

	b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.	This course addresses: Outcome 6 An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7	Brief list of topics to be covered	Sinusoids and Phasor (6 hours) AC Steady State Analysis (3.0 hours) AC Steady State Power (6 hours) Three-Phase Circuits (6 hours) Frequency Response (4.5 hours) Fourier Series (3 hours) Two-port Networks (4.5 hours) Magnetically-coupled Circuits (6 hours) Exams (6.5 hours)

II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS

Program Outcomes Assessed in this course

Outcome 1:

An ability to identify, formulate, and solve complex engineering problems (CEP) by applying principles of engineering, science, and mathematics.

Assessment Summary of Class Semester Averages for Outcomes (Should be provided for Fall 2019 through Spring 2022 Assessment Period)

Outcomes	1
Semester	Semester Class Average (%)
Fall 2021	83(ELEG) / 69 (CPEG)
Fall 2020	75 (ELEG) / 68 (CPEG)
Fall 2019	79 (ELEG) / 83 (CPEG)
Comments on Trend of Data (Improving or deteriorating)	The averages for this outcome trended downwards during the fall 2020 semester. In addition, the expectations were not met for the Computer Engineering program, but was met by the Electrical Engineering program. There was increase in the average value of the outcome during the fall 2021 semester. Plans have been provided to address the shortcomings in the Computer Engineering program.

*Expected Semester Class Average = 70% (or as defined by the program)

End of Semester Course Assessment Reports

Fall 2019 and Last Several Assessment Periods.

Each summary contains the following Information

1. Performance Statistics

- Total number of students in class
- The class average performance (**stated as %**) in each course outcome assessed in this class and the **two previous times course was assessed**.
- The acceptable class average for the class in each outcome area as set by your Department.
- Percentage of students who scored below the expected average in each outcome.

2. Implementation Summary

- Brief summary of plans implemented during the semester based on last assessment report

3. Perceived Problems

- Instructor's **critical evaluation** of perceived problems that affected students' performance. **Realistic problems should be identified throughout the semester and summarized in this section of the report.**

4. New Plans for Addressing Problems

- Instructor's plans for addressing the perceived problems the next time the class is taught. **These should be specific enough for another instructor to implement. Most of these should be things that, you, the instructor can implement to help students to improve. Be creative.**

5. Overall Trend over last three assessment periods

- Instructors summary of overall performance trend for each outcome measured over the last three periods.

5. Were Expectations Met?

- Answer **YES** if the **class average was above the expected average** and the **stated percentage of students** scored at or above the expected average, else answer **NO**.

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3301-P01 NETWORK THEORY II (ELECTRICAL ENGINEERING MAJORS)
FALL 2021 SEMESTER

Report Prepared by: Dr. John O. Attia
 Report Date: December 20, 2020

Semester	Analysis Type	Number of Students	Outcome 6 Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			
			Expected Class Average ¹	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2021	Direct	15	70	70	83	87
Fall 2020	Direct	19	70	70	75	63
Fall 2019	Direct	15	70	70	79	93
Implementation Summary	Items implemented from previous report or after meeting previous instructor		The following plans were implemented this semester: (i) required all the students to follow the format for writing the design project report, (ii) emphasize to the students the importance of (a) describing the experimental setup for testing the designed circuit, (b) method they used to conduct the experiments, (c) the data collected, and analyzed, and (d) interpretation of results			
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them		Two students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted. In addition, a table of comparison was not provided. Furthermore, one student did not show his laboratory work to be checked in the lab. The following will be implemented the next time the course is taught: (i) again require all students to strictly follow the format of writing the design project report, (ii) emphasize to the students the importance of describing the experimental setup for testing the designed circuit (iii) require all students to include a table of comparison of results in their reports, (iv) stress the importance of labeling figures and mentioning the figures in the text of the report, (v) to give the students extra incentive to spend more time and energy on the design project, I will increase the current weight of 10% of final course grade to 16%, and decrease the current weight of the class exams from 48% to 42%.			
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas		The fall 2021 student outcome value is far higher than those obtained in fall 2020 and fall 2019.			
Overall Trend over Periods	Ascertain if there were improvements over previous semesters					
Were Expectations Met?			YES			

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3301-P01 NETWORK THEORY II (COMPUTER ENGINEERING MAJORS)
FALL 2021 SEMESTER

Report Prepared by: Dr. John O. Attia

Report Date: December 20, 2021

Semester	Analysis Type	Num ber of Stud ents	Outcome 6 Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			
			Expected Class Average/	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2021	Direct	7	70	70	69	57
Fall 2020	Direct	11	70	70	68	36
Fall 2019	Direct	14	70	70	83	100
Implementation Summary	Items implemented from previous report or after meeting previous instructor		The following plans were implemented this semester: (i) required all the students to follow the format for writing the design project report, (ii) emphasize to the students the importance of (a) describing the experimental setup for testing the designed circuit, (b) method they used to conduct the experiments, (c) the data collected, and analyzed, and (d) interpretation of results			
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them		3 of the 7 students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted. In addition, a table of comparison was not provided. Furthermore, two of the seven students did not demonstrate to instructor in the lab that the design specifications have been met.			
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas		The following will be implemented the next time the course is taught: (i) again require all students to strictly follow the format of writing the design project report, (ii) emphasize to the students the importance of describing the experimental setup for testing the designed circuit (iii) require all students to include a table of comparison of results in their reports, (iv) stress the importance of labeling figures and mentioning the figures in the text of the report, (v) stress the importance of the instructor checking the designed work in the lab to ascertain that the design requirements have been met, (vi) to give the students extra incentive to spend more time and energy on the design project, I will increase the current weight of 10% of final course grade to 16%, and decrease the current weight of the class exams from 48% to 42%.			
Overall Trend over Periods	Ascertain if there were improvements over previous semesters		The fall 2021 student outcome score is slightly higher than that of fall 2020. However, the expectations were not met.			
Were Expectations Met?			NO			

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3013-Z02 NETWORK THEORY II (ELECTRICAL ENGINEERING MAJORS)
FALL 2020 SEMESTER

Report Prepared by: Dr. John O. Attia
 Report Date: December 21, 2020

Semester	Analysis Type	Number of Students	Outcome 6 Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			
			Expected Class Average ¹	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2020	Direct	19	70	70	75	63
Fall 2019	Direct	15	70	70	79.2	93.3
Implementation Summary	Items implemented from previous report or after meeting previous instructor		The following plans were implemented this semester: (i) required all the students to follow the format for writing the design project report, (ii) emphasize to the students the importance of (a) describing the experimental setup for testing the designed circuit, (b) method they used to conduct the experiments, (c) the data collected, and analyzed, and (d) interpretation of results			
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them		Some of the students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted. In addition, a table of comparison was not provided. Furthermore, there were some students who were not able to use MATLAB magnitude response plots to obtain the resonant and cut-off frequencies. The following will be implemented the next time the course is taught: (i) again require all students to strictly follow the format of writing the design project report, (ii) emphasize to the students the importance of describing the experimental setup for testing the designed circuit (iii) require all students to include a table of comparison of results in their reports, (iv) instruct the students how to obtain critical frequencies, such as resonant and cut-off frequencies, from MATLAB magnitude response plot, and (v) stress the importance of labeling figures and mentioning the figures in the text of the report.			
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas					
Overall Trend over Periods	Ascertain if there were improvements over previous semesters		The fall 2020 student outcome value is slightly higher than that of fall 2019 semester.			
Were Expectations Met?			NO			

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3013-P02 NETWORK THEORY II (COMPUTER ENGINEERING MAJORS)
FALL 2020 SEMESTER

Report Prepared by: Dr. John O. Attia

Report Date: December 20, 2020

Semester	Analysis Type	Number of Students	Sub-Outcome 2.1 Ability to identify the specific needs to be met by defining/understanding the Problem and developing plans for the project to satisfy the need			
			Expected Class Average/	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2020	Direct	11	70	70	68	36
Fall 2019	Direct	14	70	70	83	100
Implementation Summary		Items implemented from previous report or after meeting previous instructor	The following plans were implemented this semester: (i) required all the students to follow the format for writing the design project report, (ii) emphasize to the students the importance of (a) describing the experimental setup for testing the designed circuit, (b) method they used to conduct the experiments, (c) the data collected, and analyzed, and (d) interpretation of results			
Perceived Problems		Perceived problems are directly related to the PC and the sub items under them	Some of the students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted. In addition, a table of comparison was not provided. Furthermore, there were some students who were not able to use MATLAB magnitude response plots to obtain the resonant and cut-off frequencies. The following will be implemented the next time the course is taught: (i) again require all students to strictly follow the format of writing the design project report, (ii) emphasize to the students the importance of describing the experimental setup for testing the designed circuit (iii) require all students to include a table of comparison of results in their reports, (iv) instruct the students how to obtain critical frequencies, such as resonant and cut-off frequencies, from MATLAB magnitude response plot, and (v) stress the importance of labeling figures and mentioning the figures in the text of the report			
Plans for Addressing Problems		Plans for address specific measures to address PC and their sub areas	The fall 2020 student outcome value is slightly less than that of fall 2019 semester.			
Overall Trend over Periods		Ascertain if there were improvements over previous semesters				
Were Expectations Met?			NO			

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3013-P02 NETWORK THEORY II (ELECTRICAL ENGINEERING MAJORS)
FALL 2019 SEMESTER

Report Prepared by: Dr. John O. Attia

Report Date: December 19, 2019

Semester	Analysis Type	Number of Students	Outcome 6 Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			
			Expected Class Average/	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2019	Direct	15	70	70	79.2	93.3
Implementation Summary	Items implemented from previous report or after meeting previous instructor	The students designed circuits that meet some specifications, built the circuit, tested the circuit in the laboratory and ascertained that the specifications were met. In addition, the students wrote reports that have the following parts: (i) introduction, (ii) circuit design with calculations, (iii) experimental setup to test the designed circuit, (iv) conducting the experiment, (v) analysis and interpretation of experimental results, (vi) discussion of results, and (vii) conclusions.				
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them	Some of the students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted.				
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas	The following plans will be implemented the next time the course is taught: (a) require all the students to follow the format for writing the design project report. The instructor will not accept project reports that do not have the required format that address all the parts of Outcome 6. (b) Emphasize to the students the importance of (i) describing the experimental setup for testing the designed circuit, (ii) method they used to conduct the experiments, (iii) the data collected, and analyzed, and (iv) interpretation of results.				
Overall Trend over Periods	Ascertain if there were improvements over previous semesters	This is the first time this outcome was measured. There is no previous data to comment on the overall trend of this outcome.				
Were Expectations Met?		YES				

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 3013-P02 NETWORK THEORY II (COMPUTER ENGINEERING MAJORS)
FALL 2019 SEMESTER

Report Prepared by: **Dr. John O. Attia**

Report Date: **December 19, 2019**

Semester	Analysis Type	Number of Students	Sub-Outcome 2.1 Ability to identify the specific needs to be met by defining/understanding the Problem and developing plans for the project to satisfy the need			
			Expected Class Average/	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2019	Direct	14	70	70	83.1	100
Implementation Summary	Items implemented from previous report or after meeting previous instructor	The students designed circuits that meet some specifications, built the circuit, tested the circuit in the laboratory and ascertained that the specifications were met. In addition, the students wrote reports that have the following parts: (i) introduction, (ii) circuit design with calculations, (iii) experimental setup to test the designed circuit, (iv) conducting the experiment, (v) analysis and interpretation of experimental results, (vi) discussion of results, and (vii) conclusions.				
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them	Some of the students did not follow the required format for writing the project report. This resulted in students writing reports without describing in detail the experimental setup and how the experiments were conducted.				
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas	The following plans will be implemented the next time the course is taught: (a) require all the students to follow the format for writing the design project report. The instructor will not accept project reports that do not have the required format that address all the parts of Outcome 6. (b) Emphasize to the students the importance of (i) describing the experimental setup for testing the designed circuit, (ii) method they used to conduct the experiments, (iii) the data collected, and analyzed, and (iv) interpretation of results.				
Overall Trend over Periods	Ascertain if there were improvements over previous semesters	This is the first time this outcome was measured. There is no previous data to comment on the overall trend of this outcome.				
Were Expectations Met?		YES				

**NETWORK THEORY II
FALL 2021**

Title of Assignment: EXAM 1

TOPICS COVERED IN EXAM 1

Test 1 covered the following topics:

1. Complex Numbers
2. Sinusoids and Phasors
3. AC Steady State Analysis

**NETWORK THEORY II
FALL 2021**

**SAMPLE TEST QUESTIONS, SOLUTION,
AND GRADING SCHEME FOR EXAM #1**

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301 NETWORK THEORY II
FALL 2021

EXAM #1-B

Name: JOHN ATTIA SID: KEY

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks I provided.

1. (25 points) (a) Evaluate the following complex number and put your answer in polar form:

$$Z = \frac{(4 - j3)(8 + j10)}{(10 + j12)} - j13$$
$$Z = 3.328 - j2.393 - j13$$
$$= 3.328 - j15.39$$
$$= 15.75 \angle -77.80^\circ$$

12 pts

Answer is 15.75 $\angle$ -77.80°

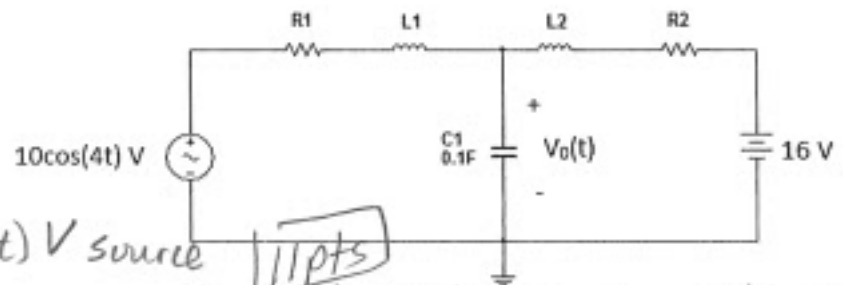
(b) Evaluate the following complex number and put your answer in rectangular form:

$$Z = \frac{60 \angle 45^\circ}{4 + j4} + (16 + j12)$$
$$Z = 10.61 + (16 + j12)$$
$$= 26.61 + j12$$
$$= 29.19 \angle 24.28^\circ$$

13 pts

Answer is 26.61 + j12.0

2. (25 points) Solve for $v_o(t)$ in the circuit shown below using the superposition principle. Assume that $R_1 = R_2 = 4 \text{ Ohms}$, and $L_1 = L_2 = 1.0 \text{ H}$.



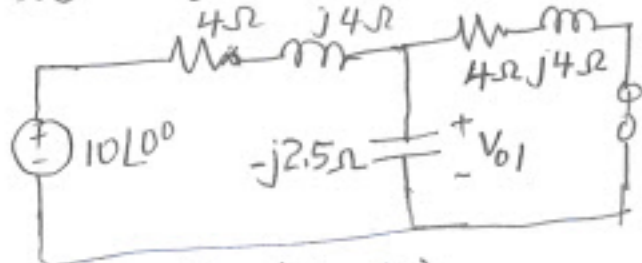
11 pts

Considering the $10\cos(4t) \text{ V}$ source we have

$$Z_{L1} = Z_{L2} = j\omega L_1 = j(4)(1) = j4 \Omega$$

$$Z_C = \frac{1}{j\omega C} = \frac{-j}{(4)(0.1)} = -j2.5 \Omega$$

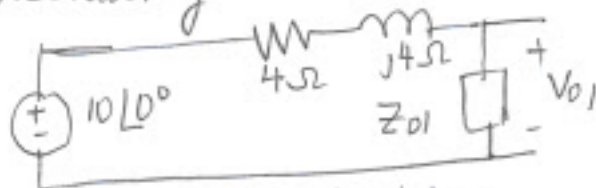
We have this circuit



$$Z_{01} = (-j2.5) \parallel (4 + j4)$$

$$Z_{01} = \frac{(-j2.5)(4 + j4)}{4 + j1.5} = 3.31 \angle -65.56^\circ$$

Redrawing the circuit, we have



Using voltage division

$$V_{o1} = \frac{(10 \angle 0^\circ)(3.31 \angle -65.56^\circ)}{(4 + j4) + (3.31 \angle -65.56^\circ)}$$

$$= \frac{(10 \angle 0^\circ)(3.31 \angle -65.56^\circ)}{5.46 \angle 10.41^\circ}$$

$$= 6.06 \angle -75.96^\circ \text{ V}$$

$$v_{o1}(t) = 6.06 \cos(4t - 75.96^\circ)$$

$$v_o(t) = 8 + 6.06 \cos(4t - 75.96^\circ) \text{ V}$$

3 pts

11 pts

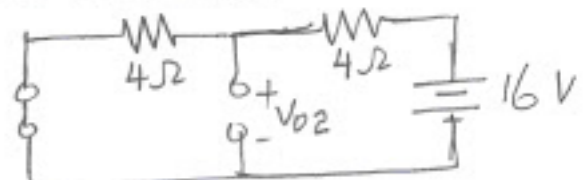
Considering the 16 V source we have

$$\omega = 0 \text{ rad/s,}$$

$$Z_{L1} = Z_{L2} = j\omega L = 0 \Omega \text{ (short circuit)}$$

$$Z_C = \frac{-j}{\omega C} = \frac{-j}{(0)(C)} \rightarrow \infty \text{ (open-circuit)}$$

We have the circuit



Using voltage division

$$V_{o2} = \frac{16(4)}{4 + 4} = 8 \text{ V}$$

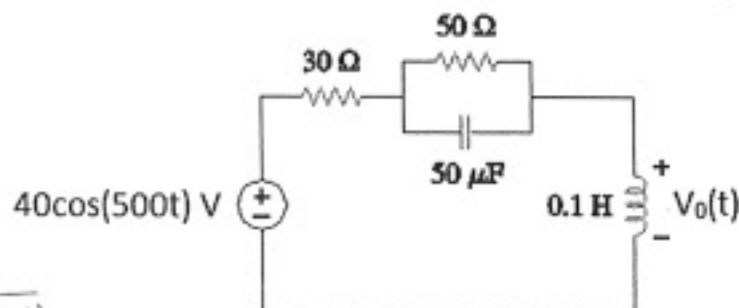
Thus,

$$v_o(t) = v_{o1}(t) + v_{o2}(t)$$

$$= 6.06 \cos(4t - 75.96^\circ) + 8 \text{ V}$$

KEY

3. (25 points) (a) Calculate $v_o(t)$ in the circuit shown below. (b) Determine the current supplied by the voltage source.



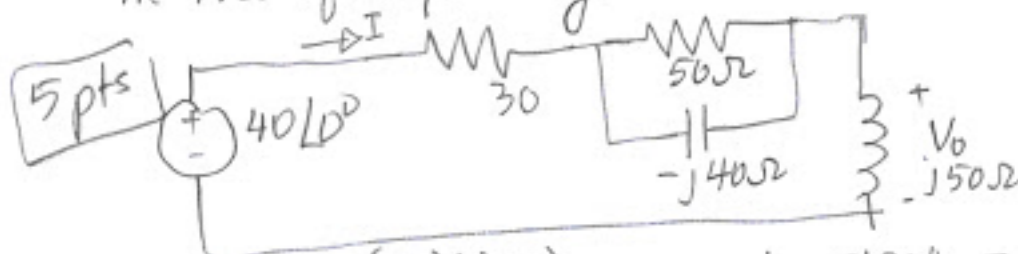
$$\omega = 500 \text{ rad/s}$$

$$Z_L = j\omega L = j(500)(0.1) = j50 \Omega$$

$$Z_C = \frac{-j}{\omega C} = \frac{-j}{(500)(50 \times 10^{-6})} = \frac{-j10^3}{25} = -j40 \Omega$$

$$V = 40 \angle 0^\circ \text{ V}$$

In the frequency domain we have



$$50 \parallel (-j40) = \frac{(50)(-j40)}{50 - j40} = 31.23 \angle -51.34^\circ = 19.51 - j24.39$$

Using voltage division, $V_o = \frac{(40 \angle 0^\circ)(j50)}{(30 + j50) + 31.23 \angle -51.34^\circ}$

$$V_o = \frac{j2000}{55.74 \angle 27.35^\circ} = 35.86 \angle 62.64^\circ = 16.48 + j31.86$$

$$v_o(t) = 35.88 \cos(500t + 62.64^\circ) \text{ V}$$

Using KVL, $I = \frac{(40 \angle 0^\circ)}{(30 + j50) + 31.23 \angle -51.34^\circ} = \frac{40 \angle 0^\circ}{55.74 \angle 27.35^\circ}$

$$I = 0.72 \angle -27.35^\circ$$

$$i(t) = 0.72 \cos(500t - 27.35^\circ)$$

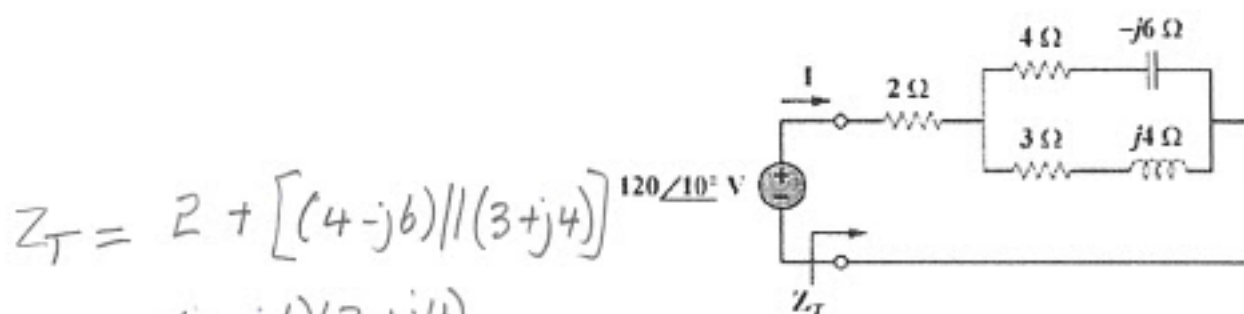
$$v_o(t) = 35.88 \cos(500t + 62.15^\circ) \text{ V}$$

Current supplied by the voltage source = $0.72 \cos(500t - 27.35^\circ) \text{ A}$

Exam #1-B

4. (25 points) Determine I and Z_T for the circuit shown below.

KEY



$$Z_T = 2 + [(4-j6) \parallel (3+j4)]$$

$$Z_T = 2 + \frac{(4-j6)(3+j4)}{4-j6+3+j4}$$

13pts

$$= 2 + \frac{(4-j6)(3+j4)}{7-j2}$$

$$= 2 + 4.95 \angle 12.77^\circ$$

$$= 6.92 \angle 9.10^\circ = 6.83 + j1.09 \Omega$$

Using Ohm's Law

12pts

$$I = \frac{V}{Z_T} = \frac{120 \angle 10^\circ}{6.92 \angle 9.10^\circ}$$

$$= 17.35 \angle 0.89^\circ$$

$$= 17.346 + j0.2716 \text{ A}$$

$$Z_T = \frac{6.917 \angle 9.103^\circ}{6.83 + j1.09} \text{ ohms}$$

$$I = \frac{17.35 \angle 0.897^\circ}{17.346 + j0.2716} \text{ A}$$

Exam #1-B

ABOVE AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301 NETWORK THEORY II
FALL 2021

EXAM #1-B

Name: IVAN CORONADO SID: _____

85
+ 10

95%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks I provided.

1. (25 points) (a) Evaluate the following complex number and put your answer in polar form:

$$Z = \frac{(4 - j3)(8 + j10)}{(10 + j12)} - j13$$

$$Z = \left[\frac{(62 + j16)}{(10 + j12)} \right] - j13$$

$$Z = \left[\frac{203}{61} - j\frac{146}{61} \right] - j13$$

$$Z = \frac{203}{61} - j\frac{939}{61}$$

25

$3.32 - j15.39$

Polar form

$$\frac{\sqrt{922930}}{61} \angle$$

15.74

$$90 \cdot \left(\frac{\tan^{-1}\left(\frac{203}{939}\right) \pi}{90} - \pi \right)$$

-77.80°

Answer is _____

(b) Evaluate the following complex number and put your answer in rectangular form:

$$Z = \frac{60 \angle 45^\circ}{4 + j4} + (16 + j12)$$

$$= 10.60 + (16 + j12)$$

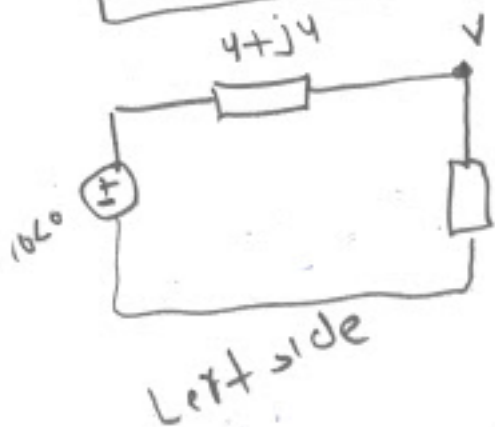
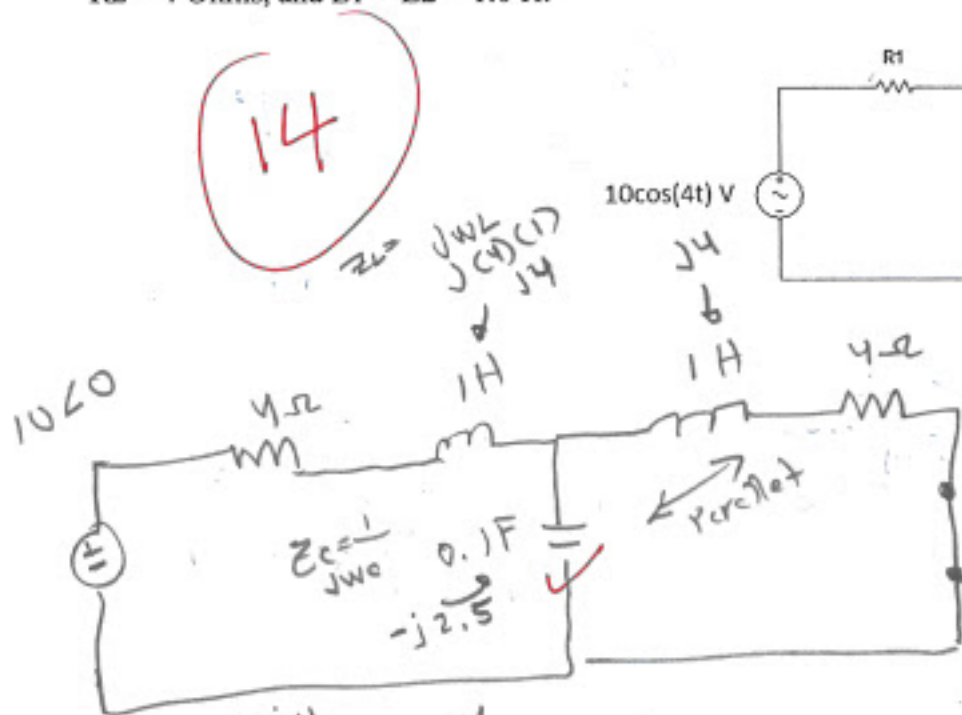
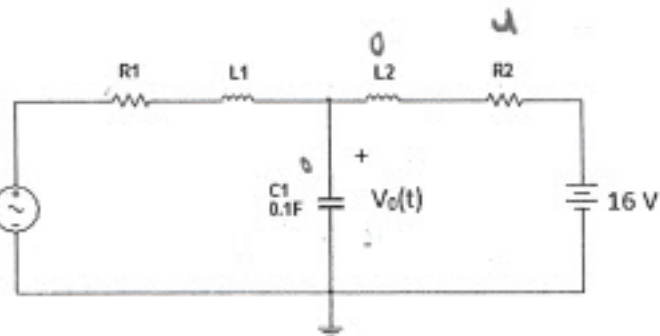
$$= 26.6066 + j12$$

← Rectangular

Answer is _____

$26.6066 + j12$

2. (25 points) Solve for $v_o(t)$ in the circuit shown below using the superposition principle. Assume that $R1 = R2 = 4 \text{ Ohms}$, and $L1 = L2 = 1.0 \text{ H}$.



$$4 + j4 \parallel -j2.5 = \frac{10 - j10}{4 + j1.5} = 1.3678 - j3.0137$$

$$10 \angle 0^\circ \left(\frac{1.3678 - j3.0137}{4 + j4 + 1.3678 - j3.0137} \right)$$

$$10 \angle 0^\circ \left(\frac{1.3678 - j3.0137}{5.3698 + j0.9863} \right)$$

$$10 \angle 0^\circ \left(0.6063 \angle -75.96^\circ \right)$$

$$V_{-j2.5} = (0.06341 \angle -75.96^\circ)$$

Right side



~~zero incomplete - 8~~

$$v_o(t) = (0.06341 \angle -75.96^\circ) [V]$$

put into the time domain

3. (25 points) (a) Calculate $v_o(t)$ in the circuit shown below. (b) Determine the current supplied by the voltage source.

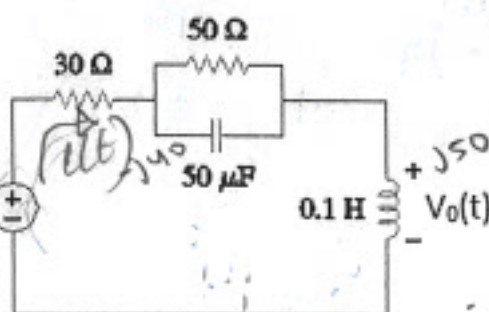
$$Z_C = \frac{1}{j\omega C}$$

$$Z_C = \frac{1}{j(500)(50 \times 10^{-6})}$$

$$Z_C = \frac{1}{j(0.025)}$$

$$Z_C = -j40$$

$$Z_L = j\omega L = j(500)(0.1) = j50$$

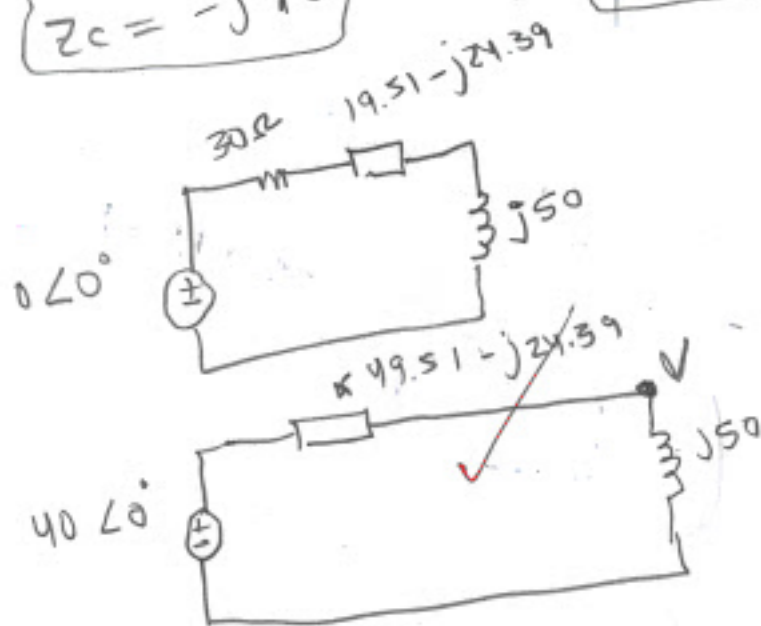


$$50 \Omega \parallel -j40$$

$$= \frac{-j2000}{50 - j40}$$

$$= \left(\frac{800}{41} - j \frac{1000}{41} \right)$$

$$= (19.51 - j24.39) \Omega$$



voltage divider

$$40 \angle 0^\circ \left(\frac{j50}{49.51 - j24.39 + j50} \right)$$

$$40 \angle 0^\circ \times \frac{j50}{49.51 + j25.61}$$

$$V_{iso} = 16.48 + j31.86 \text{ [V]}$$

$$I = \frac{V}{Z_{eq}}$$

$$I = \frac{40 \angle 0^\circ}{49.51 + j25.61}$$

$$I = 0.6373 - j0.3296 \text{ or } 0.7175 \angle -27.31^\circ \text{ [A]}$$

R FORM

POLAR FORM

$$v_o(t) = 16.48 + j31.86 \text{ [V]} \text{ or } 35.86 \angle 62.64^\circ$$

put in time domain -2

$$30 + 19.51 - j24.39 + j50$$

$$\text{Current supplied by the voltage source} = 0.7175 \angle -27.31^\circ \text{ [A]}$$

POLAR FORM

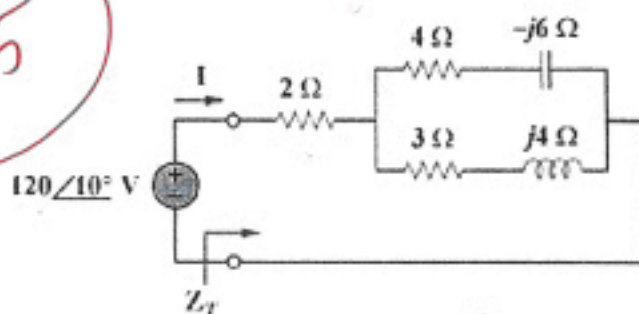
put in time domain -2

Exam #1-B

4. (25 points) Determine I and Z_T for the circuit shown below.

4Ω series $-j6 = 4 - j6$
 3Ω series $j4 = 3 + j4$

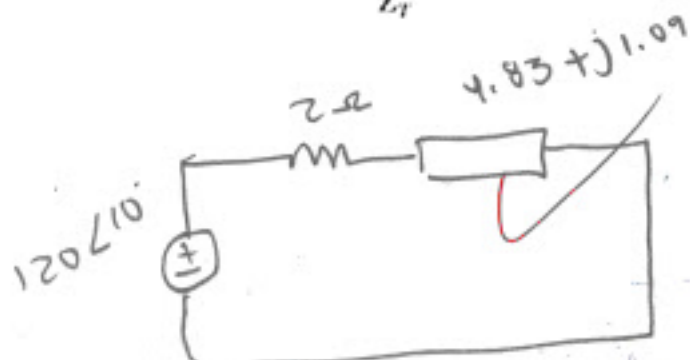
25



$4 - j6 \parallel 3 + j4$

$= \frac{36 - j2}{7 - j2}$

$= 4.83 + j1.09$



$I = \frac{120 \angle 10^\circ}{6.83 + j1.09}$

$I = \frac{120 \angle 10^\circ}{6.91 \angle 9.10^\circ}$

$I = 17.36 \angle 0.9^\circ$

$Z_T = 6.83 + j1.09$ or $6.91 \angle 9.10^\circ$

$I = 17.36 \angle 0.9^\circ$

AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301 NETWORK THEORY II
FALL 2021

EXAM #1-B

66
+10

76%

Name: Trimon Jordan SID: P21585556

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks I provided.

1. (25 points) (a) Evaluate the following complex number and put your answer in polar form:

$$Z = \frac{(4-j3)(8+j10)}{(10+j12)} - j13$$

25 $Z = \frac{(4-j3)(8+j10)}{10+j12} = 3.33 - \cancel{15.4} j15.4$

Answer is $3.33 - j15.4$ and $15.75 \angle -77.8^\circ$ polar

(b) Evaluate the following complex number and put your answer in rectangular form:

$$Z = \frac{60 \angle 45^\circ}{4+j4} + (16+j12)$$

$$\frac{60 \angle 45^\circ}{4+j4} + (16+j12) = 26.01 + j12$$

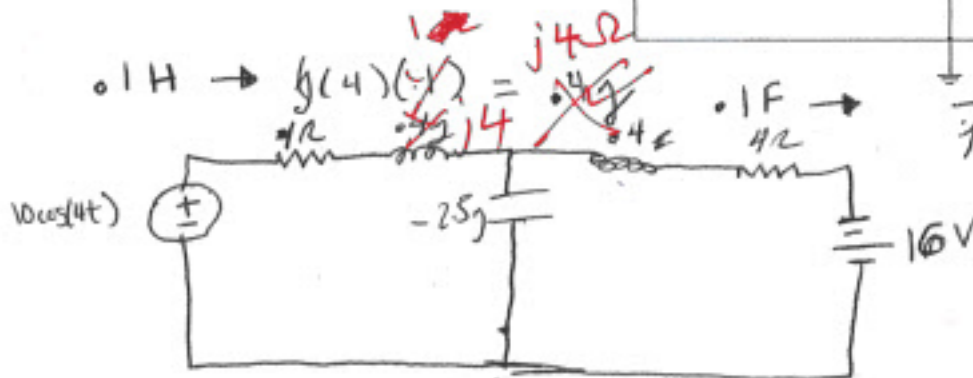
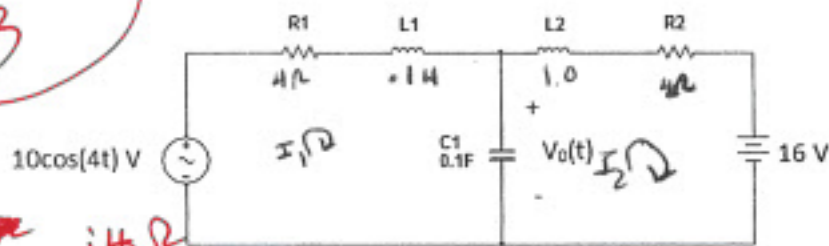
Answer is $\frac{26.01 + j12}{29.2 \angle 24.3^\circ}$ polar

Exam #1-B

2. (25 points) Solve for $v_o(t)$ in the circuit shown below using the superposition principle. Assume that $R_1 = R_2 = 4 \text{ Ohms}$, and $L_1 = L_2 = 1.0 \text{ H}$.



3



$v_o = 4 + j4 - 25 = -21 - j21$

$\frac{1}{j(4)(0.1)} = -j25 \text{ F}$

$10\cos(4t) = 2 + j4 = \frac{2}{2}$
 $16 = 4 + j4 = \frac{2}{25}$

$4 - 21j$

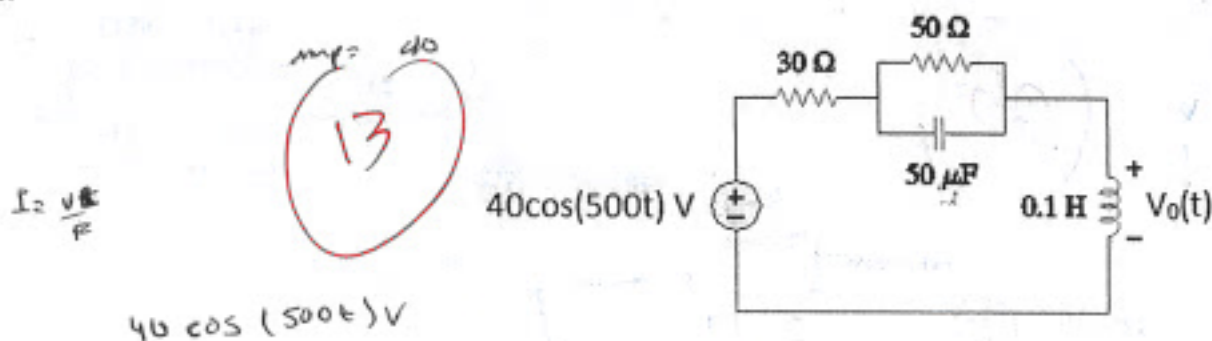
Consider 16 V dc source

-11

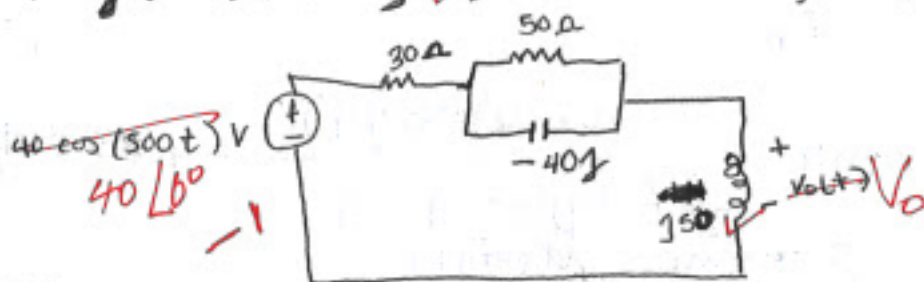
$v_o(t) =$

-3

3. (25 points) (a) Calculate $v_o(t)$ in the circuit shown below. (b) Determine the current supplied by the voltage source.



Handwritten calculations: $j(500)(.1) = j50$, $50 \mu F \Rightarrow \frac{1}{j(500)(50 \times 10^{-6})} = -j40$



Handwritten calculation: $50 || -40 j$

Handwritten calculation: $\frac{50 \times (-40 j)}{50 + (-40 j)} = 19.5 - j24.4 j$

Handwritten calculation: $30 + 19.5 - j24.4 j$

Handwritten calculation: $49.5 - j24.4 || j50$

Handwritten calculation: $\frac{49.5 - j24.4 \times j50}{49.5 - j24.4 + j50} = 20.23 - j10.5$

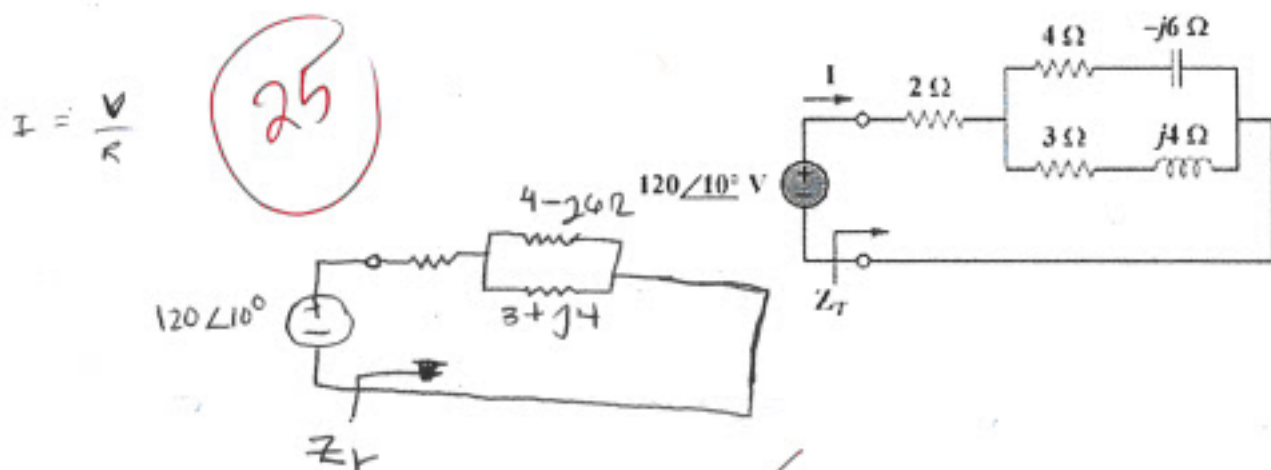
Handwritten calculations: $40 \angle 0^\circ$, $22.8 \angle -27.43^\circ$, $20.23 - j10.5 j \rightarrow \text{polar}$, $= 1.56 + j8 j$, $1.75 \angle 27.43^\circ$

Handwritten calculation: $V_o = ? -4$

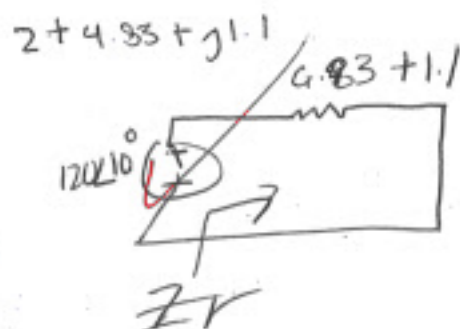
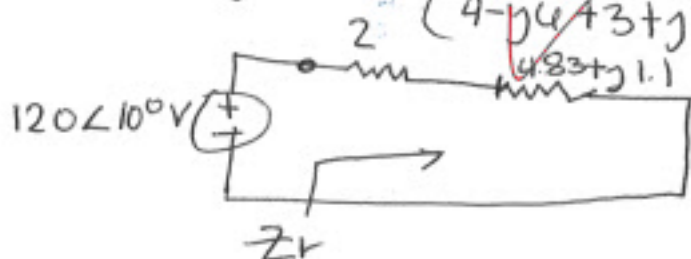
Handwritten calculation: $v_o(t) =$ (crossed out)

Handwritten calculation: Current supplied by the voltage source = (crossed out)

4. (25 points) Determine I and Z_T for the circuit shown below.



$$4 - j6 \parallel 3 + j4 = \frac{(4 - j6)(3 + j4)}{(4 - j6) + (3 + j4)} = 4.83 + j1.1$$



Z is impedance

$4.83 + j1.1 \rightarrow \text{polar}$

$$\frac{120 \angle 10^\circ}{6.92 \angle 9.1^\circ} = 17.34 \angle 0.9^\circ$$

$$Z_T = 6.92 \angle 9.1^\circ$$

$$I = 17.34 + j0.27 \text{ or } 17.34 \angle 0.9^\circ$$

BELOW AVERAGE

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DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301 NETWORK THEORY II
FALL 2021

EXAM #1-B

58%

Name: Joseph Livingston SID: _____

48
+10

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks I provided.

1. (25 points) (a) Evaluate the following complex number and put your answer in polar form:

$$Z = \frac{(4 - j3)(8 + j10)}{(10 + j12)} - j13$$

10

$$\left(\frac{203}{61} - j \frac{146}{61} \right) - j13$$

$$= \boxed{13.2677 \angle -89.91930}$$

-6

Answer is $\boxed{\frac{203}{61} - j \frac{939}{61}}$

in polar form.

(b) Evaluate the following complex number and put your answer in rectangular form:

$$Z = \frac{60 \angle 45^\circ}{4 + j4} + (16 + j12)$$

$$60 \angle 45 = 30\sqrt{2} + 30\sqrt{2}j$$

$$\frac{30\sqrt{2} + 30\sqrt{2}j}{4 + j4} + (16 + j12)$$

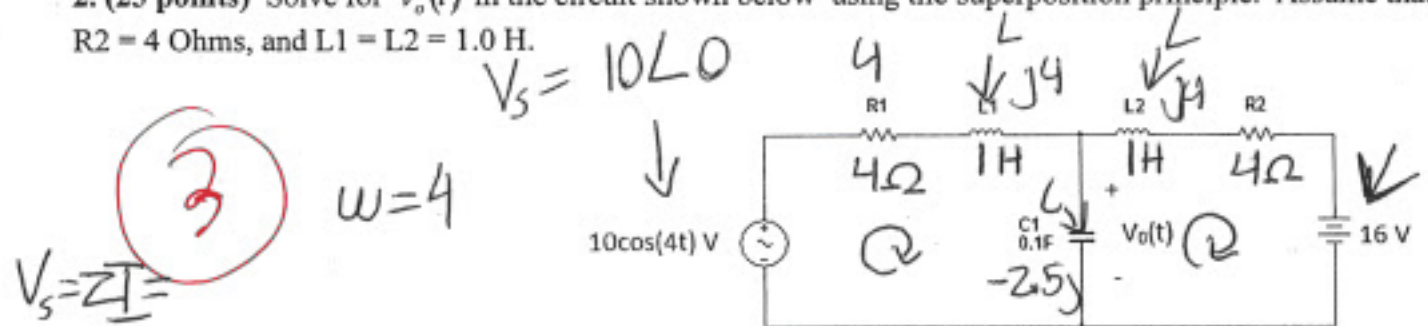
-9

Answer is $\boxed{29.1875 \angle 24.2761}$

in rectangular form

Exam #1-B

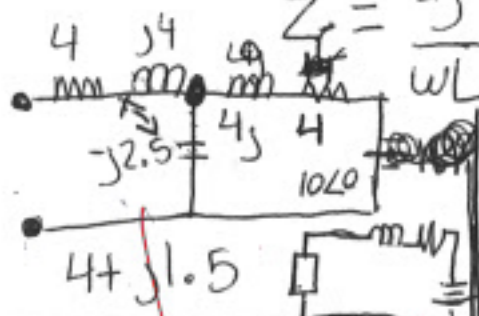
2. (25 points) Solve for $v_o(t)$ in the circuit shown below using the superposition principle. Assume that $R1 = R2 = 4 \text{ Ohms}$, and $L1 = L2 = 1.0 \text{ H}$.



$$Z_L = j\omega L = j(1)(4) = j4$$

$$Z_C = \frac{-j}{\omega L} = \frac{-j}{(4)(0.1)} = -j2.5$$

$$\frac{Z_C(V_s)}{Z_L + Z_C}$$



considering 16 V source

-11

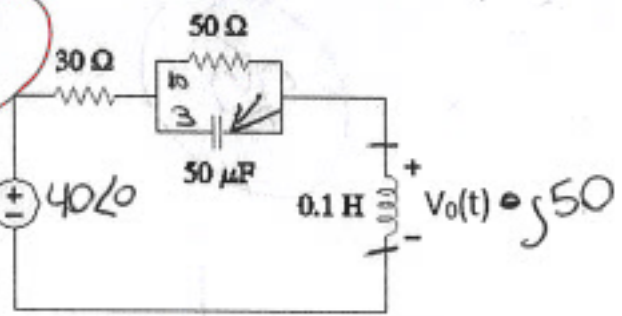
$$\frac{-j2.5(10 \angle 0)}{4 + j1.5} = -8$$

$v_o(t) =$

3. (25 points) (a) Calculate $v_o(t)$ in the circuit shown below. (b) Determine the current supplied by the voltage source.

$\omega = 500$

10



$Z_{eq} = 40 \angle 0^\circ$

$Z_L = j\omega L = j(0.1)(500) = j50$

~~$Z_C = \dots$~~

$Z_C = \frac{-j}{500(50 \times 10^{-6})} = -j40$

-2

$30 + \frac{50(10)}{50 + j40} + j50$

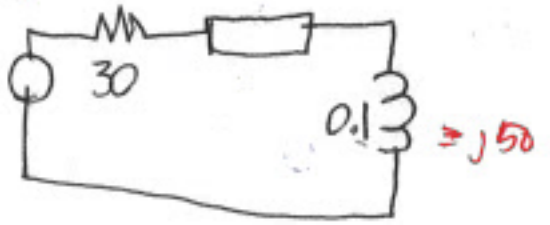
$I = \frac{V_o}{Z}$

$V_o = ZI$

30 + current divider rule + j50 =

~~$50 \parallel -j40 = \dots$~~

~~$\frac{50(-j40)}{50 - j40} = \frac{200}{629} + \frac{2500j}{629}$~~



$30 + \left(\frac{200}{629} + \frac{2500j}{629} \right) + j50$

$Z = 29.682 + j53.97$

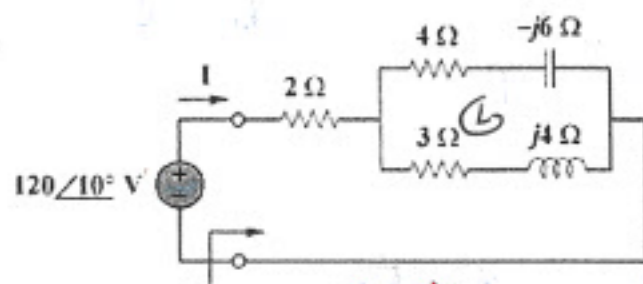
~~$v_o(t) = 29.682 + j53.97$~~

Current supplied by the voltage source =

~~$\frac{3734}{11933} - \frac{6790j}{11933}$~~

4. (25 points) Determine I and Z_T for the circuit shown below.

25



$$Z_T = \frac{1}{\frac{1}{Z}}$$

$$120\angle 10^\circ = \left((4-j6) \parallel (3+j4) \right) + 2 \bigg) I$$

$$I = \frac{120\angle 10^\circ}{6.9173\angle 9.1026^\circ}$$

$$I = 17.34568 + j0.27169$$

$$\frac{1}{2} + \frac{1}{4} + \frac{1}{-j6} \parallel \frac{1}{3} + \frac{1}{j4} =$$

$$Z_T = \frac{480}{600} + \frac{j11}{600}$$

$Z_T =$ _____

$I =$ _____

Exam #1-B

**NETWORK THEORY II
FALL 2021**

Title of Assignment: EXAM #2

TOPICS COVERED IN EXAM #2

- 1. AC Steady State Power**
- 2. Three-phase Circuits**

**NETWORK THEORY II
FALL 2021**

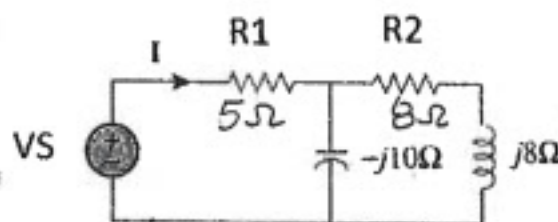
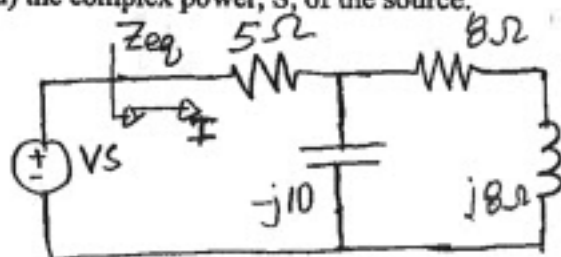
**SAMPLE QUIZ QUESTIONS, SOLUTION,
AND GRADING SCHEME FOR EXAM #2**

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
NETWORK THEORY II - ELEG 3301 P01
FALL 2021
EXAM 2 (B)

Name: JOHN ATTIA SID: KEY

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (25 points) For the entire circuit shown below, $R_1 = 5 \Omega$, $R_2 = 8 \Omega$, and $V_S = 25 \angle 45^\circ V_{rms}$ calculate:
(a) the current I , (b) the power factor, pf, of the source, (c) the average power delivered by the source, P , and
(d) the complex power, S , of the source.



$$\begin{aligned}
 Z_{eq} &= 5 + [-j10 \parallel (8 + j8)] \\
 Z_{eq} &= 5 + \frac{(-j10)(8 + j8)}{-j10 + 8 + j8} \\
 \text{[5pts]} \quad &= 5 + \frac{(8 + j8)(-j10)}{8 - j2} \\
 &= 5 + 11.76 - j7.05 \\
 &= 16.76 - j7.059 = 18.18 \angle -22.81^\circ
 \end{aligned}$$

$$\begin{aligned}
 \text{a) } I &= \frac{V_S}{Z_{eq}} = \frac{25 \angle 45^\circ}{18.18 \angle -22.81^\circ} \\
 \text{[5pts]} \quad &= 1.375 \angle 67.81^\circ
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) } pf &= \cos(\theta_v - \theta_i) = \cos(45^\circ - 67.81^\circ) \\
 \text{[5pts]} \quad &= \cos(-22.81^\circ) = 0.922
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) } P &= V_{rms} I_{rms} \cos(\theta_v - \theta_i) \\
 \text{[5pts]} \quad &= (25)(1.375)(0.922) = 31.69 W
 \end{aligned}$$

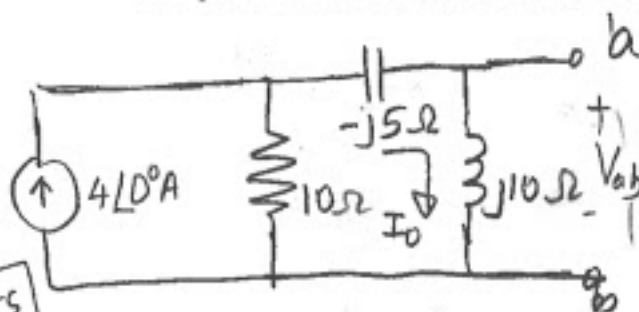
$$\begin{aligned}
 \text{(d) } Q &= V_{rms} I_{rms} \sin(\theta_v - \theta_i) \\
 &= (25)(1.375) \sin(-22.81^\circ) \\
 &= -13.33 \text{ VAR} \\
 S &= P + jQ \\
 &= 31.69 - j13.33 \text{ VA}
 \end{aligned}$$

$$I = 1.375 \angle 67.81^\circ \quad pf = 0.922 \quad P = 31.69 W \quad S = 31.69 - j13.33 \text{ VA}$$

Exam 2(B)

KEY

2. (20 points) In the circuit shown below, $R = 10 \Omega$. (a) What is the Thevenin Equivalent circuit at nodes a and b? (b) What is the load impedance Z that needs to be connected to nodes a and b for maximum power transfer to the load? (c) What is the maximum power transferred to the load. Assume that the current source is given as $4\cos(100t) \text{ A}$.



6pts

a) Thevenin voltage calculation

$$V_{Th} = V_{ab} = (j10)I_0$$

Using current division

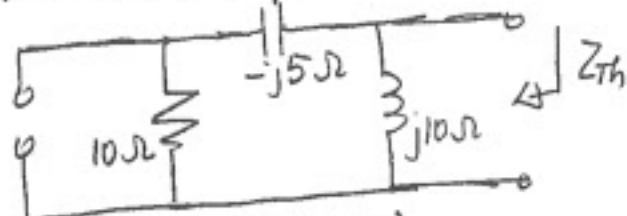
$$I_0 = \frac{(4\angle 0^\circ)(10)}{10 - j5 + j10} = \frac{40\angle 0^\circ}{10 + j5}$$

$$= 3.58 \angle -26.57^\circ$$

$$V_{Th} = (j10)(3.58 \angle -26.57^\circ)$$

$$= 35.8 \angle 63.43^\circ \text{ V}$$

b) Thevenin impedance calculation



$$Z_{Th} = j10 \parallel (10 - j5)$$

$$= \frac{(j10)(10 - j5)}{j10 + 10 - j5}$$

$$= \frac{(j10)(10 - j5)}{10 + j5} = 16 \angle 36.86^\circ$$

$$= 8 + j6 \Omega$$

7pts

Thevenin voltage = $35.8 \angle 63.43^\circ$

Load impedance $Z = 8 - j6 \Omega$

Thevenin impedance = $8 + j6 \Omega$

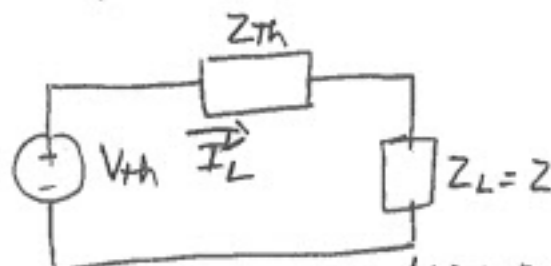
maximum power transferred to load = 20.07 W

c) For maximum power transfer

6pts

$$Z = Z_L = Z_{Th}^* = (8 + j6)^* = 8 - j6 \Omega$$

(d)



$$I_L = \frac{V_{Th}}{V_{Th} + Z_L} = \frac{35.8 \angle 63.43^\circ}{(8 - j6) + (8 + j6)}$$

$$= \frac{35.8 \angle 63.43^\circ}{16}$$

$$= 2.24 \angle 63.43^\circ \text{ A}$$

Power dissipated in the load

$$P_L = I_{rms} \text{Re}\{Z_L\}$$

$$= \left(\frac{2.24}{\sqrt{2}}\right)^2 \times 8$$

$$= \frac{1}{2} \times 2.24^2 \times 8$$

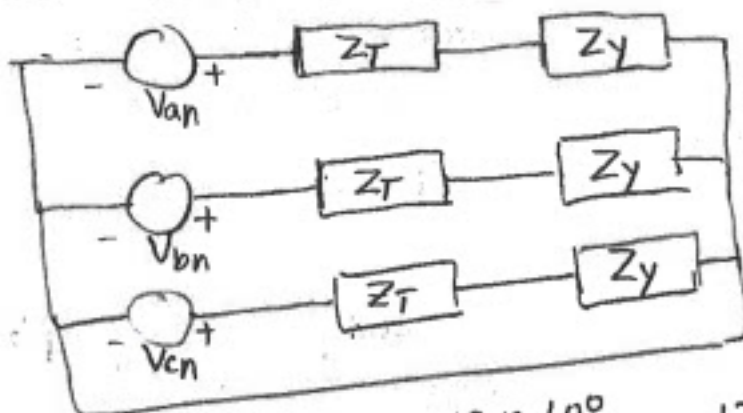
$$= 20.07 \text{ W}$$

6pts

Exam 2(B)

KEY

3. (25 points). In a balanced three-phase Y-Y system, the source is an *abc* sequence of voltages and $V_{an} = 120 \angle 0^\circ$ V rms. The transmission line impedance per phase is $1.0 + j2 \Omega$, while the per-phase impedance of the load is $4.0 + j10 \Omega$. (i) Calculate the magnitude of the line current, (ii) determine the total power dissipated in the 3-phase load, (iii) calculate the total average power supplied by the 3-phase source.



$$V_{an} = 120 \angle 0^\circ \text{ V rms}$$

$$Z_T = 1 + j2 \Omega$$

$$Z_Y = 4 + j10 \Omega$$

(i) Using KVL, $I_a = \frac{120 \angle 0^\circ}{Z_T + Z_Y} = \frac{120 \angle 0^\circ}{(1+j2) + (4+j10)} = \frac{120 \angle 0^\circ}{5 + j12}$

9pts $I_a = 9.23 \angle -67.38^\circ$, $|I_a| = 9.23 \text{ A rms}$

(ii) Power dissipated in the load, $P_L = 3 |I_a|^2 \text{Re}\{Z_Y\}$

8pts $P_L = 3 \times 9.23^2 \times 4 = 1022.31 \text{ W}$

(iii) The total power supplied by the source is the sum of the power dissipated in the transmission line and the load

8pts $P_{\text{source}} = P_S = 3 |I_a|^2 \text{Re}\{Z_T\} + 3 |I_a|^2 \text{Re}\{Z_Y\}$

$$\begin{aligned} P_S &= 3 \times 9.23^2 (1) + 1022.31 \\ &= 255.58 + 1022.31 \\ &= 1277.89 \text{ W} \end{aligned}$$

Line current = 9.23 A rms

total power to load = 1022.3 W

Total power supplied by 3-phase source = 1277.9 W

key

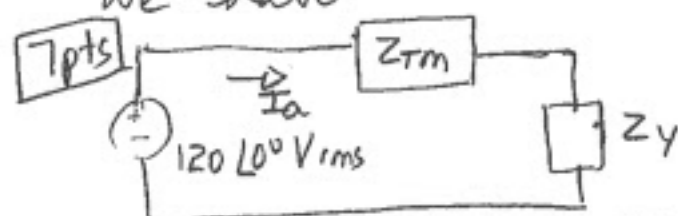
4. (25 points) For the figure shown below, load per phase, $Z_L = 6 + j9 \Omega$, and transmission line impedance per phase, $Z_{TM} = 1.0 + j1.0 \Omega$. (a) Calculate the magnitude of the line current, (b) determine the total power absorbed by the delta connected load, (c) calculate the total power dissipated in the transmission line impedances Z_{TM} of the 3-phase system.

Converting the delta-connected load to wye-connected load

$$Z_Y = \frac{Z_L}{3} = \frac{6 + j9}{3} = 2 + j3 \Omega$$

6pts

Considering one phase of the resulting wye-wye system, we have



$$I_a = \frac{V_{an}}{Z_{TM} + Z_Y} = \frac{120 \angle 0^\circ}{(1 + j1) + (2 + j3)} = \frac{120 \angle 0^\circ}{3 + j4} = 24 \angle -53.13^\circ$$

6pts

$$|I_a| = 24 \text{ A rms}$$

(ii) Total power absorbed by the load, $P_L = 3 |I_a|^2 \text{Re}\{Z_Y\}$

6pts

$$P_L = 3 \times 24^2 \times 2 = 3456 \text{ W}$$

(iii) Total power dissipated by transmission line, P_T

$$P_T = 3 |I_a|^2 \text{Re}\{Z_{TM}\} = 3 \times 24^2 \times 1 = 1728 \text{ W}$$

Magnitude of line current = 24 A Total power absorbed by 3-phase load = 3456 W

Total power dissipated in the transmission line impedance = 1728 W

ABOVE AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
NETWORK THEORY II - ELEG 3301 P01
FALL 2021
EXAM 2 (B)

Name: Jarrod Ballou

SID: P21031866

86
+14

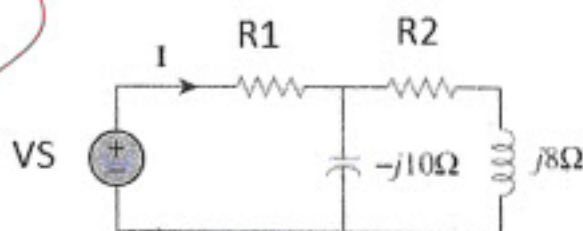
100% Excellent Wv
V. Good.

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (25 points) For the entire circuit shown below, $R_1 = 5 \Omega$, $R_2 = 8 \Omega$, and $V_S = 25 \angle 45^\circ \text{ V rms}$ calculate:
 (a) the current I , (b) the power factor, pf, of the source, (c) the average power delivered by the source, P , and
 (d) the complex power, S , of the source.

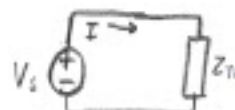
$$\begin{aligned} Z_{Th} &= 5 + (-j10 \parallel 8 + j8) \\ &= 5 + 11.76 - j7.06 \\ &= 16.76 - j7.06 \Omega \end{aligned}$$

23



$$I = \frac{V_S}{Z_{Th}} = \frac{25 \angle 45^\circ}{16.76 - j7.06} = 1.374 \angle 67.83^\circ \text{ A}$$

$$\text{pf} = \cos(\theta_V - \theta_I) = \cos(45^\circ - 67.83^\circ) = 0.9217$$



$$P = \cancel{(25)(1.374) \cos(45^\circ - 67.83^\circ)} = \cancel{15.83 \text{ W}} \quad \text{(already in rms)}$$

$$S = I_{rms}^2 R_c[Z] + j I_{rms}^2 \text{Im}[Z]$$

$$S = (1.374)^2 (16.76) + j (1.374)^2 (7.06)$$

$$S = 31.64 + j13.33 \text{ W}$$

$I = \underline{1.374 \angle 67.83^\circ \text{ A}}$ $\text{pf} = \underline{0.9217}$

$P = \underline{\cancel{15.83 \text{ W}}}$

$S = \underline{\cancel{31.64 + j13.33 \text{ W}}}$

Exam 2(B)

2. (20 points) In the circuit shown below, $R = 10 \Omega$. (a) What is the Thevenin Equivalent circuit at nodes a and b? (b) What is the load impedance Z that needs to be connected to nodes a and b for maximum power transfer to the load? (c) What is the maximum power transferred to the load. Assume that the current source is given as $4\cos(100t) \text{ A}$.

$$Z = j10 \parallel (10 - j5)$$

$$= \frac{j10 \times (10 - j5)}{j10 + 10 - j5}$$

$$Z = 8 + j6$$

MAX power to load

$$P = I_{rms}^2 R_c[Z]$$

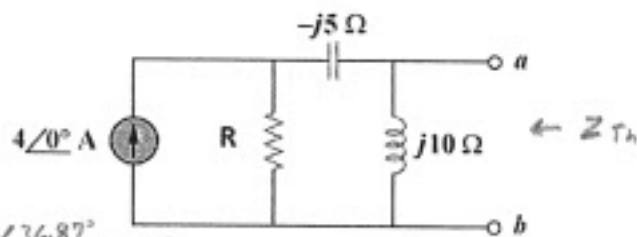
$$P = (4)^2 (8)$$

$$P = 128 \text{ W}$$

$$V_{Th} = I \cdot R = (4 \angle 0^\circ)(8 + j6) = 40 \angle 36.87^\circ$$

$$= 40 \cos(100t + 36.87^\circ)$$

use current division and ohm's law



$$\text{Thevenin voltage} = 40 \cos(100t + 36.87^\circ) \text{ V}$$

$$\text{Load impedance } Z = 8 + j6 \Omega$$

$$Z = Z_{Th}^*$$

$$\text{Thevenin impedance} = 8 + j6 \Omega$$

$$\text{maximum power transferred to load} = 128 \text{ W}$$

Exam 2(B)

3. (25 points). In a balanced three-phase Y-Y system, the source is an *abc* sequence of voltages and $V_{an} = 120\angle 0^\circ$ V rms. The transmission line impedance per phase is $1.0 + j2 \Omega$, while the per-phase impedance of the load is $4.0 + j10 \Omega$. (i) Calculate the magnitude of the line current, (ii) determine the total power dissipated in the 3-phase load, (iii) calculate the total average power supplied by the 3-phase source.

$$I_a = \frac{V_{an}}{Z_T + Z_Y} = \frac{120\angle 0^\circ}{5 + j12} = 9.231\angle -67.38^\circ \text{ A}$$

25

Total power dissipated to phase load

$$P = 3I_{rms}^2 \text{Re}[Z]$$

$$P = 3(9.231)^2(4)$$

$$P = 1023 \text{ W}$$

Total power supplied by source

$$P = 3I_{rms}^2 \text{Re}[Z_T + Z_Y]$$

$$P = 3(9.231)^2(5)$$

$$P = 1278 \text{ W}$$

Line current = 9.23 A

total power to load = 1023 W

Total power supplied by 3-phase source = 1278 W

4. (25 points) For the figure shown below, load per phase, $Z_L = 6 + j9 \Omega$, and transmission line impedance per phase, $Z_{TM} = 1.0 + j1.0 \Omega$. (a) Calculate the magnitude of the line current, (b) determine the total power absorbed by the delta connected load, (c) calculate the total power dissipated in the transmission line impedances Z_{TM} of the 3-phase system.

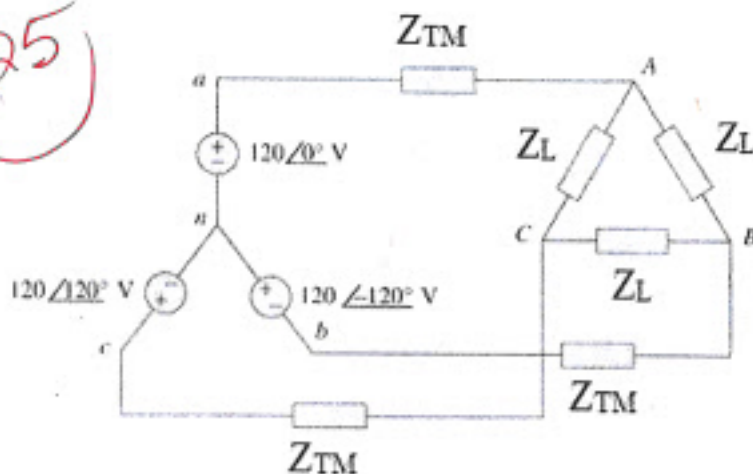
$$Z_L = Z_\Delta \quad Z_Y = \frac{Z_\Delta}{3} = \frac{6 + j9}{3} = 2 + j3 \Omega$$

25

$$I_a = \frac{V_{an}}{Z_{TM} + Z_Y} = \frac{120 \angle 0^\circ}{3 + j4} = 24 \angle -53.13^\circ$$

$$I_b = 24 \angle -173.13^\circ$$

$$I_c = 24 \angle 66.87^\circ$$

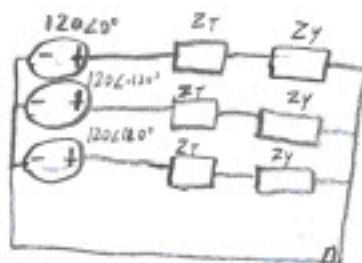


Total Power of 3 phase load

$$P = 3 I_{rms}^2 R_e[Z_L] \\ = 3 (24)^2 (2) \\ = 3456 \text{ W}$$

Total Power dissipated in transmission

$$P = 3 I_{rms}^2 R_e[Z_{TM}] \\ = 3 (24)^2 (1) \\ = 1728 \text{ W}$$



Magnitude of line current = 24 A Total power absorbed by 3-phase load = 3456 W

Total power dissipated in the transmission line impedance = 1728 W

AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
NETWORK THEORY II - ELEG 3301 P01
FALL 2021
EXAM 2 (B)

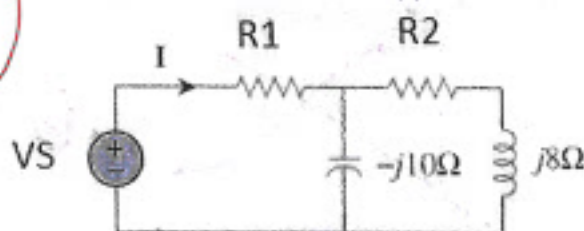
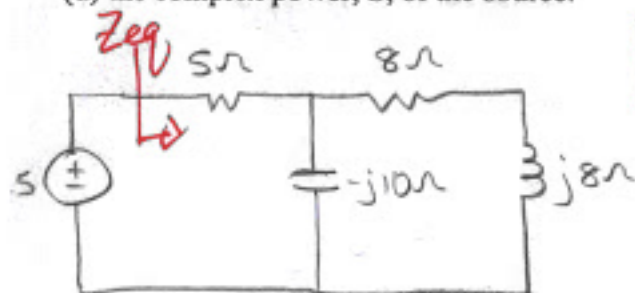
Name: Clivano Rolle SID: P21773530

56
+14

70%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (25 points) For the entire circuit shown below, $R_1 = 5 \Omega$, $R_2 = 8 \Omega$, and $V_S = 25 \angle 45^\circ \text{ V rms}$ calculate:
(a) the current I , (b) the power factor, pf, of the source, (c) the average power delivered by the source, P , and
(d) the complex power, S , of the source.



~~$8 \Omega + j8 \Omega = 11.3 \angle 45^\circ \Omega$~~

~~$-j10 = 10 \angle 90^\circ$~~

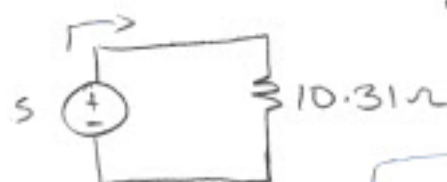
$Z_{eq} = 5 + [-j10 \parallel (8 + j8)]$

~~$11.3 \parallel j10 = \frac{11.3 \times 10}{11.3 + 10} = \frac{113}{21.3} = 5.31 \Omega$~~

~~$5.31 \Omega + 5 \Omega = 10.31 \Omega$~~

$\cos(\theta_v - \theta_i) = 3$

~~$\cos(45^\circ) = 0.707$~~



a) ~~$I = \frac{25 \angle 45^\circ}{10.31} = 2.42 \text{ A}$~~

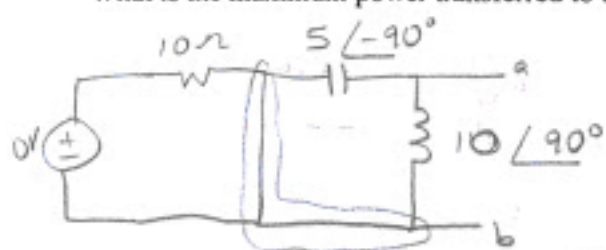
c) ~~$P = V I \cos(\theta_v - \theta_i) = (25)(2.42) \cos(45^\circ) = 42.5 \text{ W}$~~

d) ~~$S = |S| \cos(\theta) + j |S| \sin(\theta) = 25 \cos 45^\circ + j 25 \sin 45^\circ = 17.68 + j 17.68 \text{ VA}$~~

~~$I =$ _____ $\text{pf} =$ _____ $P =$ _____ $S =$ _____~~

Exam 2(B)

2. (20 points) In the circuit shown below, $R = 10 \Omega$. (a) What is the Thevenin Equivalent circuit at nodes a and b? (b) What is the load impedance Z that needs to be connected to nodes a and b for maximum power transfer to the load? (c) What is the maximum power transferred to the load. Assume that the current source is given as $4\cos(100t)$ A.



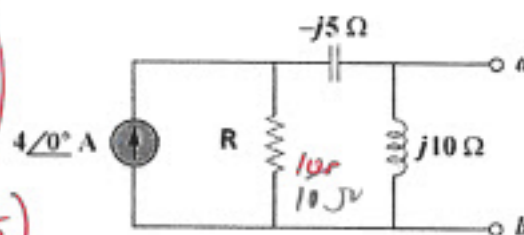
4

$$Z_{Th} = j10 \parallel (10 - j5)$$

$$Z_{Th} = \frac{5 \angle 90^\circ \times 10 \angle 90^\circ}{5 \angle 90^\circ + 10 \angle 90^\circ} = \frac{50 \angle 0^\circ}{15 \angle 0^\circ}$$

$$= 3.33 \Omega + j10 \Omega$$

$$= 13.33 \Omega$$



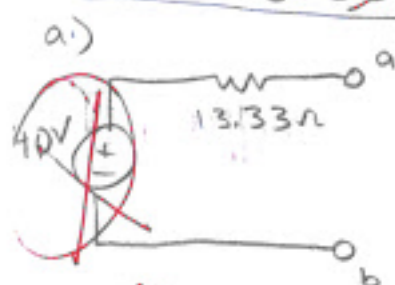
$$j10 = 10 \angle 90^\circ$$

$$-j5 = 5 \angle -90^\circ$$

$$4A \times 10\Omega = 40V$$

$$\frac{40}{13.33}$$

$$= 3.00$$



$$b.) \text{ Load Impedance} = Z_y$$

$$[R + Z]$$

$$[10\Omega + 13.33\Omega] \rightarrow Z_y = 13.33\Omega$$

$$c.) P = (I)^2 (Z_y)$$

$$= (4)^2 (13.33)$$

$$= 213.28 W$$

$$P_{3\phi} = 3 \times 213.28 W$$

$$= 639.84 W$$

Thevenin voltage = _____

Load impedance $Z =$ _____

Thevenin impedance = _____

maximum power transferred to load = _____

3. (25 points). In a balanced three-phase Y-Y system, the source is an *abc* sequence of voltages and $V_m = 120 \angle 0^\circ$ V rms. The transmission line impedance per phase is $1.0 + j2 \Omega$, while the per-phase impedance of the load is $4.0 + j10 \Omega$. (i) Calculate the magnitude of the line current, (ii) determine the total power dissipated in the 3-phase load, (iii) calculate the total average power supplied by the 3-phase source.

i) $I_a = \frac{120}{(1.0 + j2) + (4.0 + j10)}$

19

$= \frac{120}{5 + j12} = \frac{120 \angle 0^\circ}{13 \angle 67^\circ}$

$= 9.23 \angle -67^\circ$ A

$|I| = 9.23$ A

$V_{an} = 120 \angle 0^\circ$ V

$Z_T = 1.0 + j2 \Omega$

$Z_Y = 4.0 + j10 \Omega$

iii) $P = 3 V_{rms} I_{rms} \cos(\theta_v - \theta_i)$

$= 3(120)(9.23) \cos(\theta_v - \theta_i)$

$P_{3ph} = 3322.8$ W

-6

ii) $P = 3(I^2)(Z_Y)$

$= 3(9.23)^2(4)$

$P = 1022.3148$ W

Line current =

total power to load =

Total power supplied by 3-phase source =

4. (25 points) For the figure shown below, load per phase, $Z_L = 6 + j9 \Omega$, and transmission line impedance per phase, $Z_{TM} = 1.0 + j1.0 \Omega$. (a) Calculate the magnitude of the line current, (b) determine the total power absorbed by the delta connected load, (c) calculate the total power dissipated in the transmission line impedances Z_{TM} of the 3-phase system.

Y-Δ

$$Z_L = 6 + j9 \Omega$$

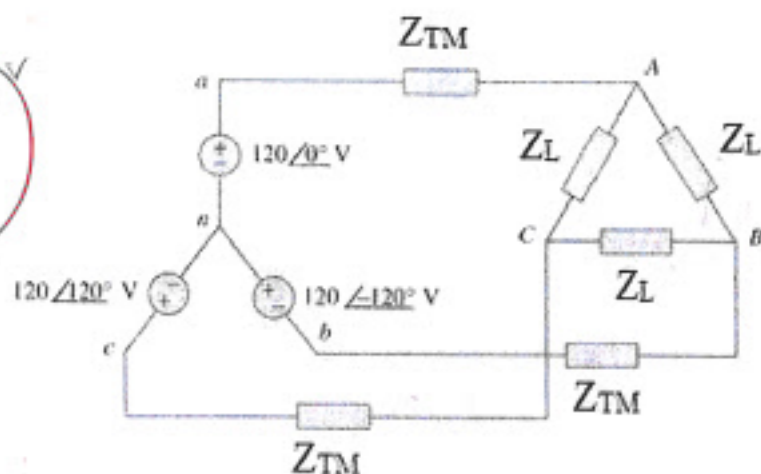
$$Z_{TM} = 1.0 + j1.0 \Omega$$

$$V = 120 \text{ V}$$

25

$$Z_Y = \frac{Z_L}{3} = \frac{6 + j9}{3}$$

$$Z_Y = 2 + j3 \Omega$$



$$a) I = \frac{V}{Z_Y + Z_{TM}} = \frac{120}{(2 + j3) + (1.0 + j1.0)} = \frac{120 \angle 0^\circ}{3.61 + j1.41} = \frac{120}{5.02}$$

$$|I| = 23.9$$

$$b) P = 3(I)^2(Z_Y) = 3(23.9)^2(2)$$

$$P_Y = 3427.26 \text{ W}$$

$$c) P = 3(I)^2(Z_{TM}) = 3(23.9)^2(1)$$

$$P_{TM} = 1713.63 \text{ W}$$

Magnitude of line current = _____ Total power absorbed by 3-phase load = _____

Total power dissipated in the transmission line impedance = _____

BELOW AVERAGE

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DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
NETWORK THEORY II - ELEG 3301 P01
FALL 2021
EXAM 2 (B)

39%

Name: Tyler Jones SID: 21807202

25
+14

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (25 points) For the entire circuit shown below, $R_1 = 5 \Omega$, $R_2 = 8 \Omega$, and $V_S = 25 \angle 45^\circ V_{rms}$ calculate:
(a) the current I , (b) the power factor, pf, of the source, (c) the average power delivered by the source, P , and
(d) the complex power, S , of the source.



15

$$Z_{eq} = 5 + \frac{(-j10)(8 + j8)}{10 + j}$$

$$Z_r = 3 + 8 + \frac{(-j10)(j8)}{10 + j}$$

$$= 3 + 8$$

$$= \frac{(2 - j10)(8 + j8)}{10 + j}$$

$$= 3.87129 - j7.28713$$

$$= (11.4805 \angle -39.4007^\circ)$$

$$P_f = .773$$

$$\underline{I} = \frac{V}{Z} = \frac{25 \angle 45^\circ}{(11.4805 \angle -39.4007^\circ)}$$

$$\underline{I} = 0.212471 + j2.16722$$

$$P = V_{rms} I_{rms} \cos(\theta_V - \theta_I)$$

$$= 0.5 V_P I_P \cos(\theta_V - \theta_I)$$

$$P = (25)(84.7) \cos(-39.40) = 92.8743$$

$$(25)(84.7) \sin(-39.40) = -39.6611$$

$$S = P + jQ =$$

$$= 92.8753 + j39.6611$$

$$=$$

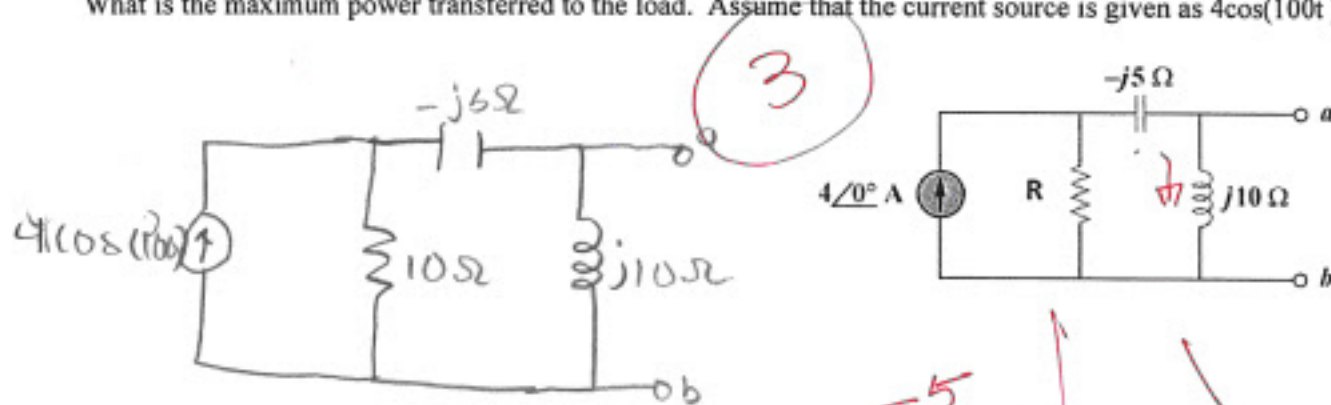
$$I = 2.178 \angle 84.40^\circ \text{ pf} = .773$$

$$P = 92.8753$$

$$S = 54.95 \angle 39.4$$

Exam 2(B)

2. (20 points) In the circuit shown below, $R = 10 \Omega$. (a) What is the Thevenin Equivalent circuit at nodes a and b? (b) What is the load impedance Z that needs to be connected to nodes a and b for maximum power transfer to the load? (c) What is the maximum power transferred to the load. Assume that the current source is given as $4\cos(100t)$ A.



3

$$-j5\Omega + (10 \parallel j10) = -j5\Omega + \frac{10 \cdot j10}{10 + j10} = 5$$

where is I_1

$$I_1 = 4(j10) \times (10 \parallel j10) = j2 + 2$$

$$Z_{Th} = j0 \parallel (10 - j5)$$

$$I_1 = 2.82843 \angle 45^\circ$$

V_{Th} : use current division and Ohm's law.

$$Z_{Thive} = 14.14 + j14.14 V = (19.997 \angle 45)$$

Thevenin voltage = ~~19.997/45~~

Thevenin impedance =

Load impedance $Z =$ ~~5~~ -6

maximum power transferred to load = -6

3. (25 points). In a balanced three-phase Y-Y system, the source is an *abc* sequence of voltages and $V_{an} = 120\angle 0^\circ$ V rms. The transmission line impedance per phase is $1.0 + j2 \Omega$, while the per-phase impedance of the load is $4.0 + j10 \Omega$. (i) Calculate the magnitude of the line current, (ii) determine the total power dissipated in the 3-phase load, (iii) calculate the total average power supplied by the 3-phase source.

(0)

-25

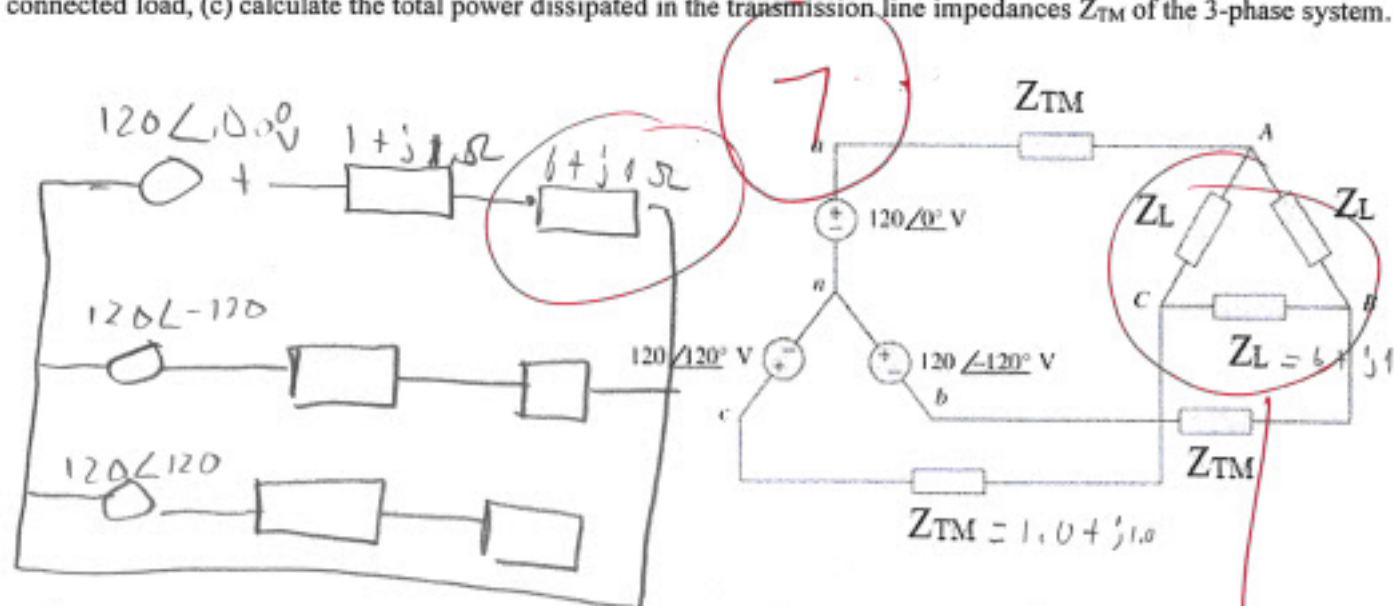
Line current =

total power to load =

Total power supplied by 3-phase source =

Exam 2(B)

4. (25 points) For the figure shown below, load per phase, $Z_L = 6 + j9 \Omega$, and transmission line impedance per phase, $Z_{TM} = 1.0 + j1.0 \Omega$. (a) Calculate the magnitude of the line current, (b) determine the total power absorbed by the delta connected load, (c) calculate the total power dissipated in the transmission line impedances Z_{TM} of the 3-phase system.



$$(1 + j1 + 6 + j9)$$

$$(7 + j10) I_0$$

$$I_0 = \frac{120 \angle 0^\circ}{7 + j10} = 9.831 \angle -55.008^\circ$$

$$I_\phi = 9.831 \angle -175.008^\circ$$

$$I_c = 9.831 \angle 64.992^\circ$$

$$3(9.831)^2(6) = 1739.32$$

-6 Convert to wye-connect load

Not required

Magnitude of line current = _____ Total power absorbed by 3-phase load = 1739.32 W

Total power dissipated in the transmission line impedance = 106.336 W

**NETWORK THEORY II
FALL 2021**

EXAM #3

TOPICS COVERED IN EXAM #3

- 1. Frequency Response**
- 2. Fourier Series**

NETWORK THEORY II
FALL 2021

EXAM #3 QUESTIONS

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021 EXAM #3(A)

Name: JOHN ATTIA SID: KEY

Note: All the steps that lead to your answer should be shown. In addition, put answers in blank provided.

1 (a). (12 points) Given a parallel RLC circuit with $R = 20 \text{ k}\Omega$, $L = 40 \text{ mH}$, and $C = 50 \text{ }\mu\text{F}$, if the circuit is magnitude-scaled by $K_m = 20$ and frequency-scaled by $K_f = 10^4$, find the resulting scaled values of R , L , and C .

$$R = 20 \text{ k}\Omega, \quad L = 40 \text{ mH}, \quad C = 50 \text{ }\mu\text{F}$$

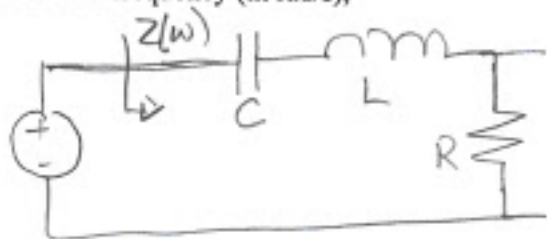
$$R' = K_m R = 20 \times 20 \text{ k} = 400 \text{ k}\Omega$$

$$L' = \frac{K_m}{K_f} L = \frac{20}{10^4} \times 40 \times 10^{-3} = 800 \times 10^{-7} = 8 \times 10^{-5} \text{ H}$$

$$C' = \frac{1}{K_f K_m} C = \frac{50 \times 10^{-6}}{(10^4)(20)} = \frac{50}{20} \times 10^{-10} = 2.5 \times 10^{-10} \text{ F}$$

scaled $R = \underline{4 \times 10^5 \Omega}$ scaled $L = \underline{8 \times 10^{-5} \text{ H}}$ scaled $C = \underline{2.5 \times 10^{-10} \text{ F}}$ 14 pts

1(b). (13 points) A series RLC network has $R = 1 \text{ k}\Omega$, $L = 36 \text{ mH}$, and $C = 0.1 \text{ }\mu\text{F}$. Calculate (a) the impedance at resonance, (b) the resonant frequency (in rad/s),



a) $Z(w) = R + j\omega L + \frac{1}{j\omega C}$
At resonance, $Z(w)$ is purely real
Thus, $Z(w_0) = R = 1 \text{ k}\Omega$

b) The resonant frequency, $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{36 \times 10^{-3} \times 0.1 \times 10^{-6}}}$
 $\omega_0 = \frac{1}{\sqrt{36 \times 10^{-10}}} = \frac{1}{6 \times 10^{-5}} = \frac{10^5}{6} = 1.666 \times 10^4 \text{ rad/s}$

Impedance at resonance = $\underline{1 \text{ k}\Omega}$ resonant frequency (in rad/s) = $\underline{1.67 \times 10^4 \text{ rad/s}}$
6 pts 7 pts Exam #3(A)

KEY

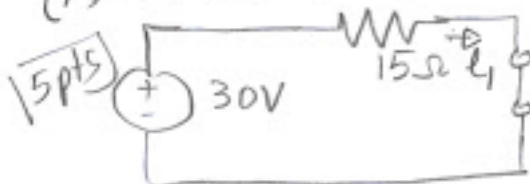
2. (25 points) For the circuit shown below, $R = 15 \text{ Ohms}$, $L = 10 \text{ mH}$. If the periodic signal $v_s(t)$ is given as:

$$V_s(t) = 30 + 10 \cos(500t + 30^\circ) + 3.33 \cos(1500t - 50^\circ) \text{ V}$$

(a) Determine the current $i(t)$ flowing through the resistor R , (b) determine the average power dissipated in the resistor R .

Using the superposition theorem

(i) For $V_{s1} = 30 \text{ V}$, we have

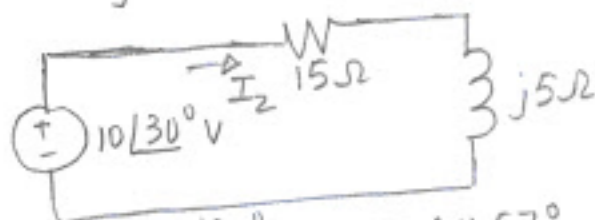


$$i_1 = \frac{30}{15} = 2 \text{ A}$$

(ii) For $V_{s2} = 10 \cos(500t + 30^\circ) \text{ V}$

$$V_{s2} = 10 \angle 30^\circ, \omega = 500 \text{ rad/s}$$

$$Z_L = j\omega L = j(500)(10 \times 10^{-3}) = j5 \Omega$$



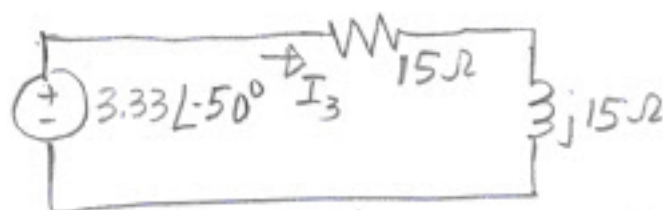
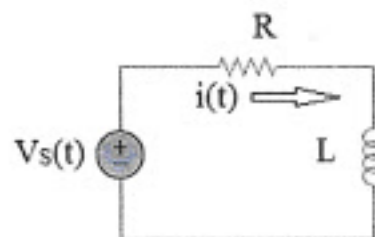
$$I_2 = \frac{10 \angle 30^\circ}{15 + j5} = 0.63 \angle 11.57^\circ$$

$$i_2(t) = 0.63 \cos(500t + 11.57^\circ) \text{ A}$$

(iii) For $V_{s3}(t) = 3.33 \cos(1500t - 50^\circ)$

$$V_{s3} = 3.33 \angle -50^\circ, \omega = 1500 \text{ rad/s}$$

$$Z_L = j\omega L = j(1500)(10 \times 10^{-3}) = j15 \Omega$$



$$I_3 = \frac{3.33 \angle -50^\circ}{15 + j15} = 0.16 \angle -95^\circ$$

$$i_3(t) = 0.16 \cos(1500t - 95^\circ) \text{ A}$$

(iv) $i(t) = i_1(t) + i_2(t) + i_3(t)$

$$= 2 + 0.63 \cos(500t + 11.57^\circ) + 0.16 \cos(1500t - 95^\circ) \text{ A}$$

$$b) P = (2)^2 \times R + \left(\frac{0.63}{\sqrt{2}}\right)^2 \times R + \left(\frac{0.16}{\sqrt{2}}\right)^2 \times R$$

Average Power, P

$$P = \left[4 + \frac{0.63^2}{2} + \frac{0.16^2}{2} \right] \times 15$$

$$= [4 + 0.198 + 0.0128] \times 15$$

$$= [4.2108] \times 15 = 63.16 \text{ W}$$

7 pts

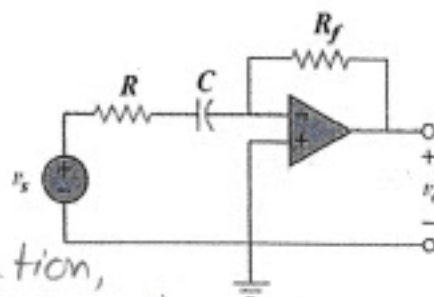
$$i(t) = 2 + 0.63 \cos(500t + 11.57^\circ) + 0.16 \cos(1500t - 95^\circ) \text{ A}$$

average power =

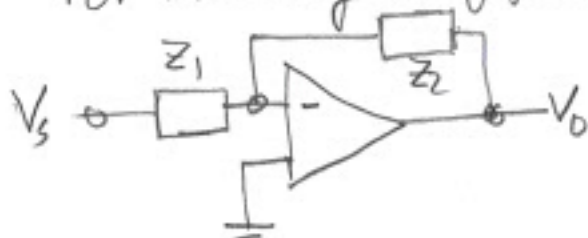
KEY

3. (25 points) (a) Find the transfer function $H(\omega)$ of the active filter shown below. (b) If $R = 5 \text{ K}\Omega$, $C = 1 \mu\text{F}$, determine the cut-off frequency (in Hz), (c) What is the gain at frequency of 500 Hz?

$$R_f = 20 \text{ K}$$



For inverting configuration,



$$\frac{V_o}{V_s} = -\frac{Z_2}{Z_1}$$

$$Z_2 = R_f$$

$$Z_1 = R + \frac{1}{j\omega C} = \frac{1 + j\omega RC}{j\omega C}$$

$$\frac{V_o}{V_s} = H(\omega) = \frac{-R_f}{(1 + j\omega RC)/j\omega C}$$

$$H(\omega) = \frac{-j\omega CR_f}{1 + j\omega RC}$$

$$= \frac{-j\omega (1.0 \times 10^{-6})(20 \times 10^3)}{1 + j\omega (5 \times 10^3)(1 \times 10^{-6})}$$

$$= \frac{-j\omega (2 \times 10^2)}{1 + j\omega (5 \times 10^{-3})}$$

15pts

$$-j\omega CR_f / (1 + j\omega RC)$$

$$H(\omega) = \dots$$

$$\text{Cutoff frequency (Hz)} = 31.82 \text{ Hz}$$

$$(b) |H(\omega)| = \frac{\omega CR_f}{\sqrt{1 + (\omega RC)^2}}$$

5pts

At the cut-off frequency

$$1 = \omega_c RC$$

$$\omega_c = \frac{1}{RC} = \frac{1}{(5 \times 10^3)(1 \times 10^{-6})}$$

$$\omega_c = \frac{10^3}{5} = \frac{10}{5} \times 10^2 = 200 \text{ rad/s}$$

$$f_c = \frac{\omega_c}{2\pi} = \frac{200}{2\pi} = 31.82 \text{ Hz}$$

$$(c) \omega = 2\pi f = 2\pi(500) = 1000\pi$$

$$|H(\omega)|_{\omega=1000\pi} = \frac{(1000\pi)(1 \times 10^{-6})(20 \times 10^3)}{\sqrt{1 + (1000\pi \times 5 \times 10^3 \times 1 \times 10^{-6})^2}}$$

$$H(\omega) = \frac{20\pi}{\sqrt{1 + (5\pi)^2}} = \frac{20\pi}{\sqrt{1 + 15.71^2}}$$

$$= \frac{20\pi}{\sqrt{247.8}} = \frac{20\pi}{15.74} = 3.99$$

5pts

$$\text{gain at frequency of 500 Hz} = 3.99$$

Exam #3(A)

KEY

4(a). (9 points) For the transfer function $H(s) = \frac{(s+10)(s+50)}{s(s+70)(s+160)}$ determine the poles of $H(s)$?

For poles; $H(s) = \frac{N(s)}{D(s)}$

$$D(s) = s(s+70)(s+160) = 0, \Rightarrow s = 0, -70, -160$$

The poles are 0, -70, -160

3 pts each

The poles are: 0, -70, -160

4(b) (16 points) The transfer function of a filter is given as: $H(s) = \frac{25}{1 + \frac{j\omega}{500}}$

(i) Determine the cutoff frequency (in Hz), (ii) Calculate the magnitude of $H(\omega)$ at $\omega = 5000$ rad/s

$$H(s) = H(\omega) = \frac{25}{1 + j\omega/500}, |H(\omega)| = \frac{25}{\sqrt{1 + \left(\frac{\omega}{500}\right)^2}}$$

(i) At the cut-off frequency

$$\frac{\omega_c}{500} = 1 \Rightarrow \omega_c = 500 \text{ rad/s},$$

$$f_c = \frac{\omega_c}{2\pi} = \frac{500}{2\pi} = \underline{79.57 \text{ Hz}}$$

$$(ii) H(\omega) \Big|_{\omega=5000} = \frac{25}{1 + j(5000)/500} = \frac{25}{1 + j10} = 2.49 \angle -84.29^\circ$$

$$|H(\omega)| = \underline{2.49}$$

Cut-off frequency = 79.6 Hz
18 pts

magnitude of $H(\omega) = \underline{2.49}$
18 pts

Exam #3(A)

ABOVE AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021 EXAM #3(A)

Name: Jarrod Ballou SID: P21031866

70/75 → 93%
Excellent

Note: All the steps that lead to your answer should be shown. In addition, put answers in blank provided.

1 (a). (12 points) Given a parallel RLC circuit with $R = 20 \text{ k}\Omega$, $L = 40 \text{ mH}$, and $C = 50 \text{ }\mu\text{F}$, if the circuit is magnitude-scaled by $K_m = 20$ and frequency-scaled by $K_f = 10^4$, find the resulting scaled values of R , L , and C .

$$R' = K_m R = 20 (20 \times 10^3) = \boxed{400 \text{ k}\Omega} \approx 400 \times 10^3$$

$$L' = \frac{K_m}{K_f} L = \frac{20}{10^4} (40 \times 10^{-3}) = \boxed{80 \text{ mH}} \approx 80 \times 10^{-6}$$

$$C' = \frac{1}{K_m K_f} C = \frac{1}{(20 \times 10^4)} (50 \times 10^{-6}) = \boxed{0.25 \text{ nF}} \approx 0.25 \times 10^{-9}$$

23

scaled $R = \underline{400 \text{ k}\Omega}$ scaled $L = \underline{80 \text{ mH}}$ scaled $C = \underline{0.25 \text{ nF}}$

1(b). (13 points) A series RLC network has $R = 1 \text{ k}\Omega$, $L = 36 \text{ mH}$, and $C = 0.1 \text{ }\mu\text{F}$. Calculate (a) the impedance at resonance, (b) the resonant frequency (in rad/s),

$$Z = (1 \times 10^3) + j\omega(36 \times 10^{-3}) + \frac{1}{j\omega(0.1 \times 10^{-6})}$$

$$= 1000 - j\omega(40 \times 10^{-6})$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(36 \times 10^{-3})(0.1 \times 10^{-6})}} = \underline{16667 \text{ rad/s}}$$

It is purely real
-2

Impedance at resonance = $1000 - j\omega(40 \times 10^{-6})$ resonant frequency (in rad/s) = 16,667

Exam #3(A)

2. (25 points) For the circuit shown below, $R = 15 \text{ Ohms}$, $L = 10 \text{ mH}$. If the periodic signal $v_s(t)$ is given as:

$$V_s(t) = 30 + 10 \cos(500t + 30^\circ) + 3.33 \cos(1500t - 50^\circ) \text{ V}$$

(a) Determine the current $i(t)$ flowing through the resistor R , (b) determine the average power dissipated in the resistor R .

DC Input

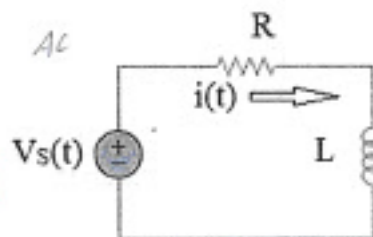
$$V_{dc} = 30 \text{ V}$$

AC Input

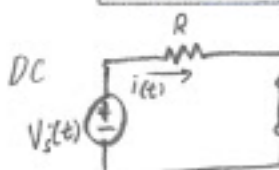
$$\omega_1 = 500, V_1 = 30 \angle 30^\circ$$

$$\omega_2 = 1500, V_2 = 3.33 \angle -50^\circ$$

AC



DC



$$I_{dc} = \frac{30 \text{ V}}{15 \Omega} = 2 \text{ A}$$

Using Voltage Division

$$\begin{aligned} \omega_1 = 500 \quad V_{R_1} &= V_1 \left(\frac{R}{R+L} \right) \\ &= 30 \angle 30^\circ \left(\frac{15}{15 + j(500)(10 \times 10^{-3})} \right) \\ &= 28.46 \angle 11.57^\circ \end{aligned}$$

Use KVL $I = \frac{V}{Z}$

$$\rightarrow I_1 = \frac{V_1}{R} = 1.90 \angle 11.57^\circ$$

$$\begin{aligned} \omega_2 = 1500 \quad V_{R_2} &= 3.33 \angle -50^\circ \left(\frac{15}{15 + j(1500)(10 \times 10^{-3})} \right) \\ &= 2.36 \angle -95^\circ \end{aligned}$$

$$\rightarrow I_2 = \frac{V_2}{R} = 0.157 \angle -95^\circ$$

$$P = VI$$

$$P_{dc} = (30)(2) = 60 \text{ W}$$

$$\begin{aligned} P_{ac} &= (28.46 \angle 11.57^\circ)(1.90 \angle 11.57^\circ) + (2.36 \angle -95^\circ)(0.157 \angle -95^\circ) = 53.76 \angle 23.36^\circ \\ &= 54.07(23.36) + 0.3705 \angle 170^\circ \end{aligned}$$

$$P = 60 + 53.76 \cos(500t + 23.36) + 0.3705 \cos(1500t + 170) \text{ W}$$

$$i(t) = \sqrt{2} + 1.90 \cos(500t + 11.57^\circ) + 0.157 \cos(1500t - 95^\circ)$$

$$\text{average power} = 60 + 53.76 \cos(500t + 23.36) + 0.3705 \cos(1500t + 170)$$

3. (25 points) (a) Find the transfer function $H(\omega)$ of the active filter shown below. (b) If $R = 5 \text{ K}\Omega$, $C = 1 \text{ }\mu\text{F}$, determine the cut-off frequency (in Hz), (c) What is the gain at frequency of 500 Hz?

$$\frac{V_i}{R_i + Z_c} = \frac{V_o}{R_f}$$

$$H(\omega) = \frac{V_o}{V_i} = \frac{-R_f}{R_i} \cdot \frac{1}{1 + j\omega CR_f}$$

$$= -\frac{20\text{K}}{5\text{K}} \cdot \frac{1}{1 + j\omega(1 \times 10^{-6})(20 \times 10^3)}$$

$$= \frac{-4}{1 + j\omega 20}$$

$$H(\omega) = \frac{-R_f}{R + 1/j\omega C}$$

$$1 = \omega 20 \rightarrow \omega = \frac{1}{20} \rightarrow f = \frac{1}{20 \cdot 2\pi} = 0.0032 \text{ Hz}$$

$$\omega = 500$$

$$H(500) = \frac{-4}{1 + j(500)(20)}$$

$$= 0.0002 \angle 90^\circ$$

Magnitude: 0.0002
Phase: 90°

$$H(\omega) = \frac{-4}{1 + j\omega 20}$$

Cutoff frequency (Hz) = $\frac{0.0032}{3.2 \text{ Hz}}$

gain at frequency of 500 Hz = $\frac{0.0002}{-5}$

Exam #3(A)

4(a). (9 points) For the transfer function $H(s) = \frac{(s+10)(s+50)}{s(s+70)(s+160)}$ determine the poles of $H(s)$?

22

The poles are: -10 and -160 0 -3

4(b) (16 points) The transfer function of a filter is given as: $H(s) = \frac{25}{1 + \frac{j\omega}{500}}$

(i) Determine the cutoff frequency (in Hz), (ii) Calculate the magnitude of $H(\omega)$ at $\omega = 5000$ rad/s

$$1 = \frac{\omega_c}{500} \rightarrow \omega_c = 500 \rightarrow f = \frac{500}{2\pi} = 79.58$$

$$H(s) = \frac{25}{1 + \frac{j(5000)}{500}} = \frac{25}{1 + j10} \approx 2.488 \angle -84.29^\circ$$

Cut-off frequency = 79.58 Hz

magnitude of $H(\omega) =$ 2.49

AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021 EXAM #3(A)

Name: Raysean Watson SID: _____

57/75 → 76%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blank provided.

1 (a). (12 points) Given a parallel RLC circuit with $R = 20 \text{ k}\Omega$, $L = 40 \text{ mH}$, and $C = 50 \text{ }\mu\text{F}$, if the circuit is magnitude-scaled by $K_m = 20$ and frequency-scaled by $K_f = 10^4$, find the resulting scaled values of R , L , and C .

$$R' = K_m R$$

$$R' = (20)(20 \times 10^3)$$

$$R' = 40 \times 10^4$$

$$L' = \frac{K_m}{K_f} L$$

$$L' = \frac{20}{10^4} (40 \times 10^{-3})$$

$$L' = 8 \times 10^{-5}$$

$$C' = \frac{1}{K_f K_m} C$$

$$C' = \frac{1}{(20)(10^4)} (50 \times 10^{-6})$$

$$C' = 2.5 \times 10^{-10}$$

23

scaled $R = 40 \times 10^4$

scaled $L = 8 \times 10^{-5}$

scaled $C = 2.5 \times 10^{-10}$

1(b). (13 points) A series RLC network has $R = 1 \text{ k}\Omega$, $L = 36 \text{ mH}$, and $C = 0.1 \text{ }\mu\text{F}$. Calculate (a) the impedance at resonance, (b) the resonant frequency (in rad/s),

$$(b) \omega_0 = \frac{1}{\sqrt{LC}}$$

$$\omega_0 = \frac{1}{\sqrt{(36 \times 10^{-3})(0.1 \times 10^{-6})}} = 16666.67 \text{ Hz}$$

$$(a) Z(j\omega) = R + j\omega L + \frac{1}{j\omega C}$$

$$= (1 \times 10^3) + j\omega(36 \times 10^{-3}) + \frac{1}{j\omega(0.1 \times 10^{-6})}$$

$$\omega = 16666.67 \text{ rad/s}$$

$$Z = (1 \times 10^3) + j(16666.67)(36 \times 10^{-3}) + \frac{1}{j(16666.67)(0.1 \times 10^{-6})}$$

$$Z = 1000 + j(2 \times 10^7)$$

Impedance at resonance = $1000 + j(2 \times 10^7)$

resonant frequency (in rad/s) = 16666.67 rad/s

Exam #3(A)

at resonance, impedance is purely real

2. (25 points) For the circuit shown below, $R = 15 \text{ Ohms}$, $L = 10 \text{ mH}$. If the periodic signal $v_s(t)$ is given as:

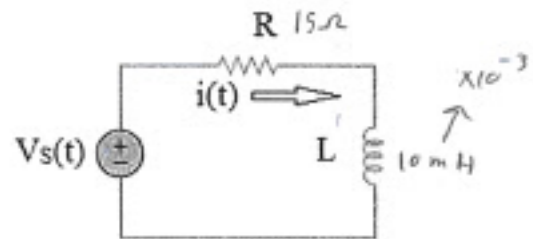
$$V_s(t) = 30 + 10 \cos(500t + 30^\circ) + 3.33 \cos(1500t - 50^\circ) \text{ V}$$

(a) Determine the current $i(t)$ flowing through the resistor R , (b) determine the average power dissipated in the resistor R .

Case 1: $V = 30$ $\omega = 0$

$$i_1(t) = \frac{30}{15 \Omega} = 2 \text{ A}$$

12



$$Z_L = j\omega L$$

Case 2: $V = 10 \angle 30^\circ$ $\omega = 500$

$$i_2(t) = \frac{10 \angle 30^\circ}{15 + j5} = 0.6 \angle -5.6^\circ \text{ A}$$

use KVL

Case 3: $V = 3.33 \angle -50^\circ$ $\omega = 1500$

$$i_3(t) = \frac{3.33 \angle -50^\circ}{15 + j5} = 0.03 \angle -2.62^\circ$$

-3

(a) $i_R(t) = 2 + 0.6 \cos(500t + 0.56) + 0.03 \cos(1500t - 2.62)$

(b) $P = \frac{2^2}{15} + \frac{(0.6/\sqrt{2})^2}{15} + \frac{(0.03/\sqrt{2})^2}{15} = [I^2 + \left(\frac{I_{m1}}{\sqrt{2}}\right)^2 + \left(\frac{I_{m2}}{\sqrt{2}}\right)^2] \times 15$

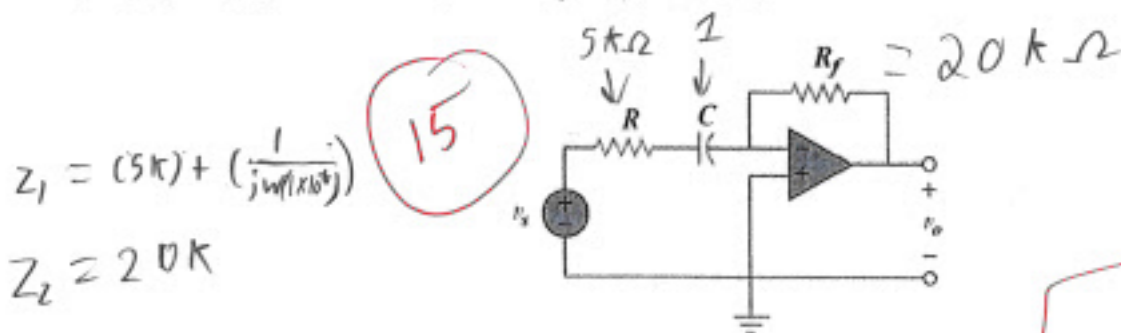
$$= 1.33 \times 10^{-4} + 1.2 \times 10^{-7} + 3 \times 10^{-8}$$

$$= 1.33 \times 10^{-4} \text{ W}$$

-6

$i(t) = 2 + 0.6 \cos(500t + 0.56) + 0.03 \cos(1500t - 2.62)$ average power = $1.33 \times 10^{-4} \text{ W}$

3. (25 points) (a) Find the transfer function $H(\omega)$ of the active filter shown below. (b) If $R = 5 \text{ k}\Omega$, $C = 1 \text{ }\mu\text{F}$, determine the cut-off frequency (in Hz), (c) What is the gain at frequency of 500 Hz?



(a)
$$\frac{V_o}{V_s} = -\frac{Z_2(s)}{Z_1(s)} = -\frac{20\text{k}}{5\text{k} + \left(\frac{1}{j\omega(1 \times 10^{-6})}\right)}$$

(b)
$$\omega = \frac{20\text{k}}{1 + (5\text{k})(1 \times 10^{-6})}$$

$$= 19.9 \times 10^3 \text{ Hz} \quad -5$$

(c)
$$V_o = -\frac{20\text{k}}{5\text{k} + (-2000i)} = 5.385 \angle -58^\circ \text{ V}$$

$$H(\omega) = -\frac{20\text{k}}{5\text{k} + \left(\frac{1}{j\omega(1 \times 10^{-6})}\right)}$$

Cutoff frequency (Hz) = $19.9 \times 10^3 \text{ Hz}$

gain at frequency of 500 Hz =

$5.385 \angle -58^\circ \text{ V}$

4(a). (9 points) For the transfer function $H(s) = \frac{(s+10)(s+50)}{s(s+70)(s+160)}$ determine the poles of $H(s)$?

7

-9

The poles are:

~~10, 50, 70, 160~~

4(b) (16 points) The transfer function of a filter is given as: $H(s) = \frac{25}{1 + \frac{j\omega}{500}}$

(i) Determine the cutoff frequency (in Hz), (ii) Calculate the magnitude of $H(\omega)$ at $\omega = 5000$ rad/s

(i) $H(s) = \frac{25}{1 + \frac{j\omega}{500}}$

$\omega = 500 \left(\frac{1}{1+25} \right)$
 $\omega = 19.23 \text{ Hz}$

$\frac{\omega_c}{500} = 1$
 $\omega_c = 500 \text{ rad/s}$
 $f_c = \frac{\omega_c}{2\pi} = \frac{500}{2\pi}$

(ii) $\frac{25}{1 + \frac{j5000}{500}} = \frac{25}{1 + j10}$

$H(\omega) = 0.25$ $\angle -1.47$
 Use your calculator to determine the magnitude

Cut-off frequency = ~~19.23 Hz~~

magnitude of $H(\omega) = \frac{0.25}{10}$

BELOW AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021 EXAM #3(A)

Name: Karthan Ross SID: P21542922

28/75 → 37%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blank provided.

1(a). (12 points) Given a parallel RLC circuit with $R = 20 \text{ k}\Omega$, $L = 40 \text{ mH}$, and $C = 50 \text{ }\mu\text{F}$, if the circuit is magnitude-scaled by $K_m = 20$ and frequency-scaled by $K_f = 10^4$, find the resulting scaled values of R , L , and C .

$$K_m = 20$$

$$K_f = 10^4$$

$$L_{\text{new}} = L \cdot K_m / K_f$$

$$L_{\text{new}} = (40 \times 10^{-3}) (20 / 10^4) = 8 \times 10^{-5} \text{ H}$$

19

$$R_{\text{new}} = K_m \cdot R$$

$$R_{\text{new}} = 20 \cdot 20,000 \Omega = 400 \text{ k}\Omega$$

$$C_{\text{new}} = C / (K_m K_f)$$

$$C_{\text{new}} = (50 \times 10^{-6}) / (20 \cdot 10^4) = 2.5 \times 10^{-10} \text{ F}$$

$$\text{scaled } R = 400 \text{ k}\Omega$$

$$\text{scaled } L = 8 \times 10^{-5} \text{ H}$$

$$\text{scaled } C = 2.5 \times 10^{-10} \text{ F}$$

1(b). (13 points) A series RLC network has $R = 1 \text{ k}\Omega$, $L = 36 \text{ mH}$, and $C = 0.1 \text{ }\mu\text{F}$. Calculate (a) the impedance at resonance, (b) the resonant frequency (in rad/s),

a.) impedance at resonance

$$R + j\omega L + 1/j\omega C$$

$$= 1000 + j\omega(36 \times 10^{-3}) + 1/j\omega(0.1 \times 10^{-6})$$

b.) resonant frequency

$$\omega_0 = 1/\sqrt{LC}$$

$$\omega_0 = 1/\sqrt{(36 \times 10^{-3})(0.1 \times 10^{-6})}$$

$$\omega_0 = 1/\sqrt{3.6 \times 10^{-9}}$$

$$\omega_0 = 1/6 \times 10^{-5}$$

$$\omega_0 = 16,666.67 \text{ rad/sec} \quad (2\pi?)$$

$$\text{Impedance at resonance} = 1000 \Omega$$

$$\text{resonant frequency (in rad/s)} = 16,666.67 \text{ rad/sec}$$

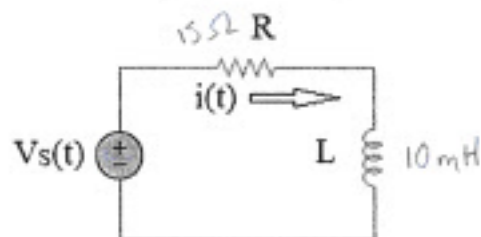
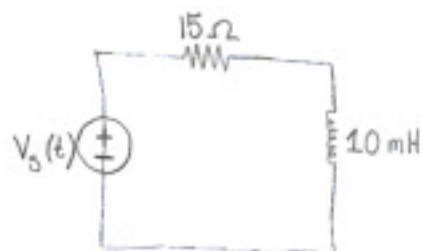
Exam #3(A)

② (25 points) For the circuit shown below, $R = 15 \text{ Ohms}$, $L = 10 \text{ mH}$. If the periodic signal $v_s(t)$ is given as:

$$V_s(t) = 30 + 10\cos(500t + 30^\circ) + 3.33\cos(1500t - 50^\circ) \text{ V}$$

(a) Determine the current $i(t)$ flowing through the resistor R , (b) determine the average power dissipated in the resistor R .

a.) current through R



b.) average power dissipated

-25

$i(t) =$

average power =

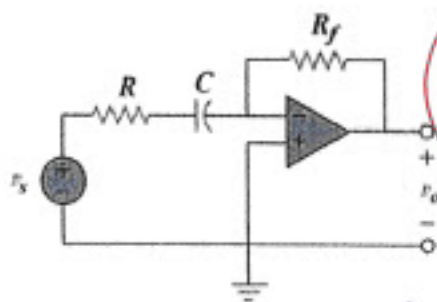
3. (25 points) (a) Find the transfer function $H(\omega)$ of the active filter shown below. (b) If $R = 5 \text{ K}\Omega$, $C = 1 \text{ }\mu\text{F}$, determine the cut-off frequency (in Hz), (c) What is the gain at frequency of 500 Hz?

a.) Transfer Function

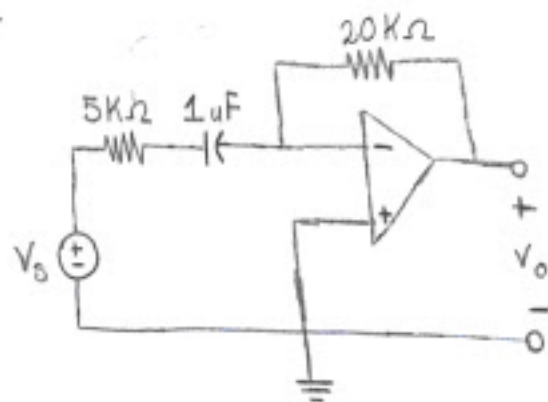
$$H(\omega) = Y(\omega) / X(\omega)$$

$$-20/5 = -4$$

-15



2



b.) cutoff frequency

$$\frac{-R_2/R_1}{j\omega C_2 R_2 + 1} = -4 / j\omega C_2 R_2 + 1$$

c.) gain at 500 Hz

$$500 \times 2\pi = 1000\pi$$

$$\frac{V_o}{V_i} = -20/5 = -4$$

when $\omega \rightarrow \infty$, Gain = 4

$$H(\omega) = \text{-----}$$

$$\text{Cutoff frequency (Hz)} = \text{-----}$$

-5

$$\text{gain at frequency of 500 Hz} = \text{-----}$$

-3

Exam #3(A)

4(a). (9 points) For the transfer function $H(s) = \frac{(s+10)(s+50)}{s(s+70)(s+160)}$ determine the poles of $H(s)$?

$$(s+10)(s+50)$$

$$s = -10, -50$$

$$s(s+70)(s+160)$$

$$s = 0, -70, -160$$

7

The poles are:

$$0, -10, -50, -70, -160$$

-6

4(b) (16 points) The transfer function of a filter is given as: $H(s) = \frac{25}{1 + \frac{j\omega}{500}}$

(i) Determine the cutoff frequency (in Hz), (ii) Calculate the magnitude of $H(\omega)$ at $\omega = 5000$ rad/s

i.) cutoff frequency

$$H(s) = \frac{25}{1 + \frac{j\omega}{500}}$$

$$= \frac{12500}{500 + j\omega}$$

$$1 = j\omega_c$$

$$j\omega = 1/500$$

$$\frac{\omega_c}{500} = 1$$

$$\omega_c = 500 \text{ rad/s}$$

$$f_c = \frac{\omega_c}{2\pi}$$

$$f_c = 2\pi \cdot \omega_c$$

$$= 2\pi \cdot 1/500$$

$$= 3.14 \times 10^{-3}$$

-6

Cut-off frequency =

ii.) magnitude at 5000 rad/sec

$$\frac{25}{1 + \frac{j\omega}{500}}$$

$$= 7.958 \angle -89.998^\circ$$

$$= 7.958$$

$$\frac{25}{1 + j\frac{(5000)}{500}}$$

magnitude of $H(\omega) =$

-6

NETWORK THEORY II
FALL 2021

EXAM #4 (FINAL EXAM)

TOPICS COVERED IN FINAL EXAM

- 1. Magnetically-coupled Circuits**
- 2. Two-port Networks**

NETWORK THEORY II
FALL 2021

FINAL EXAM QUESTIONS

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021
FINAL EXAM (A)

Name: JOHN ATTIA SID: 1KE7

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (12 points) Using the two-parameter conversion table shown below, calculate the equivalent y-parameters of a circuit whose z-parameters are given as: $z_{11} = 100 \Omega$, $z_{12} = 20 \Omega$, $z_{21} = 20 \Omega$, and $z_{22} = 40 \Omega$.

Conversion of two-port parameters.

	z		y		h		g		T		t	
z	z_{11}	z_{12}	$\frac{y_{22}}{\Delta_y}$	$-\frac{y_{12}}{\Delta_y}$	$\frac{\Delta_h}{h_{22}}$	$-\frac{h_{12}}{h_{22}}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{A}{C}$	$-\frac{\Delta_T}{C}$	$\frac{d}{c}$	$-\frac{1}{c}$
	z_{21}	z_{22}	$-\frac{y_{21}}{\Delta_y}$	$\frac{y_{11}}{\Delta_y}$	$-\frac{h_{21}}{h_{22}}$	$\frac{1}{h_{22}}$	$\frac{g_{21}}{g_{11}}$	$-\frac{\Delta_g}{g_{11}}$	$\frac{1}{C}$	$-\frac{D}{C}$	$\frac{\Delta_T}{c}$	$-\frac{a}{c}$
y	$\frac{z_{22}}{\Delta_z}$	$-\frac{z_{12}}{\Delta_z}$	y_{11}	y_{12}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$-\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{a}{b}$	$-\frac{1}{b}$
	$-\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	y_{21}	y_{22}	$\frac{h_{21}}{h_{11}}$	$\frac{\Delta_h}{h_{11}}$	$-\frac{g_{21}}{g_{22}}$	$\frac{1}{g_{22}}$	$-\frac{1}{B}$	$\frac{A}{B}$	$-\frac{\Delta_T}{b}$	$-\frac{d}{b}$
h	$\frac{\Delta_z}{z_{22}}$	$\frac{z_{12}}{z_{22}}$	$\frac{1}{y_{11}}$	$-\frac{y_{12}}{y_{11}}$	h_{11}	h_{12}	$\frac{g_{22}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	$\frac{B}{D}$	$\frac{\Delta_T}{D}$	$\frac{b}{a}$	$\frac{1}{a}$
	$-\frac{z_{21}}{z_{22}}$	$\frac{1}{z_{22}}$	$\frac{y_{21}}{y_{11}}$	$\frac{\Delta_y}{y_{11}}$	h_{21}	h_{22}	$-\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	$-\frac{1}{D}$	$\frac{C}{D}$	$\frac{\Delta_T}{a}$	$-\frac{c}{a}$
g	$\frac{1}{z_{11}}$	$-\frac{z_{12}}{z_{11}}$	$\frac{\Delta_y}{y_{22}}$	$-\frac{y_{12}}{y_{22}}$	$\frac{h_{22}}{\Delta_h}$	$-\frac{h_{12}}{\Delta_h}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{C}{A}$	$-\frac{\Delta_T}{A}$	$\frac{c}{d}$	$-\frac{1}{d}$
	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{21}}{y_{22}}$	$\frac{1}{y_{22}}$	$-\frac{h_{21}}{\Delta_h}$	$\frac{h_{11}}{\Delta_h}$	$\frac{g_{21}}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{1}{A}$	$\frac{B}{A}$	$\frac{\Delta_T}{d}$	$-\frac{b}{d}$
T	$\frac{z_{11}}{z_{21}}$	$\frac{\Delta_z}{z_{21}}$	$-\frac{y_{22}}{y_{21}}$	$-\frac{1}{y_{21}}$	$-\frac{\Delta_h}{h_{21}}$	$-\frac{h_{11}}{h_{21}}$	$\frac{1}{g_{21}}$	$\frac{g_{22}}{g_{21}}$	A	B	$\frac{d}{\Delta_T}$	$\frac{b}{\Delta_T}$
	$\frac{1}{z_{21}}$	$\frac{z_{22}}{z_{21}}$	$-\frac{\Delta_y}{y_{21}}$	$-\frac{y_{11}}{y_{21}}$	$-\frac{h_{22}}{h_{21}}$	$-\frac{1}{h_{21}}$	$\frac{g_{11}}{g_{21}}$	$-\frac{\Delta_g}{g_{21}}$	C	D	$\frac{c}{\Delta_T}$	$\frac{a}{\Delta_T}$
t	$\frac{z_{22}}{z_{12}}$	$\frac{\Delta_z}{z_{12}}$	$-\frac{y_{11}}{y_{12}}$	$-\frac{1}{y_{12}}$	$\frac{1}{h_{12}}$	$\frac{h_{11}}{h_{12}}$	$-\frac{\Delta_g}{g_{12}}$	$-\frac{g_{22}}{g_{12}}$	$\frac{D}{\Delta_T}$	$\frac{B}{\Delta_T}$	a	b
	$\frac{1}{z_{12}}$	$\frac{z_{11}}{z_{12}}$	$-\frac{\Delta_y}{y_{12}}$	$-\frac{y_{22}}{y_{12}}$	$\frac{h_{22}}{h_{12}}$	$\frac{\Delta_h}{h_{12}}$	$-\frac{g_{11}}{g_{12}}$	$-\frac{1}{g_{12}}$	$\frac{C}{\Delta_T}$	$\frac{A}{\Delta_T}$	c	d

$$\Delta_z = z_{11}z_{22} - z_{12}z_{21} \quad \Delta_h = h_{11}h_{22} - h_{12}h_{21} \quad \Delta_T = AD - BC$$

$$\Delta_y = y_{11}y_{22} - y_{12}y_{21} \quad \Delta_g = g_{11}g_{22} - g_{12}g_{21} \quad \Delta_t = ad - bc$$

$$Z = \begin{bmatrix} 100 & 20 \\ 20 & 40 \end{bmatrix} \quad \Delta Z = z_{11}z_{22} - z_{12}z_{21} = (100)(40) - (20)(20) = 4000 - 400 = 3600$$

$$y_{11} = \frac{z_{22}}{\Delta Z} = \frac{40}{3600} = \frac{1}{90} = 0.011$$

$$y_{12} = -\frac{z_{12}}{\Delta Z} = -\frac{20}{3600} = -\frac{1}{180} = -0.0055$$

$$y_{21} = -\frac{z_{21}}{\Delta Z} = -\frac{20}{3600} = -\frac{1}{180} = -0.0055$$

$$y_{22} = \frac{z_{11}}{\Delta Z} = \frac{100}{3600} = \frac{1}{36} = 0.0278$$

$$y_{11} = \frac{0.011}{1/90} \quad y_{12} = \frac{-0.0055}{-1/180} \quad y_{21} = \frac{-0.0055}{-1/180}$$

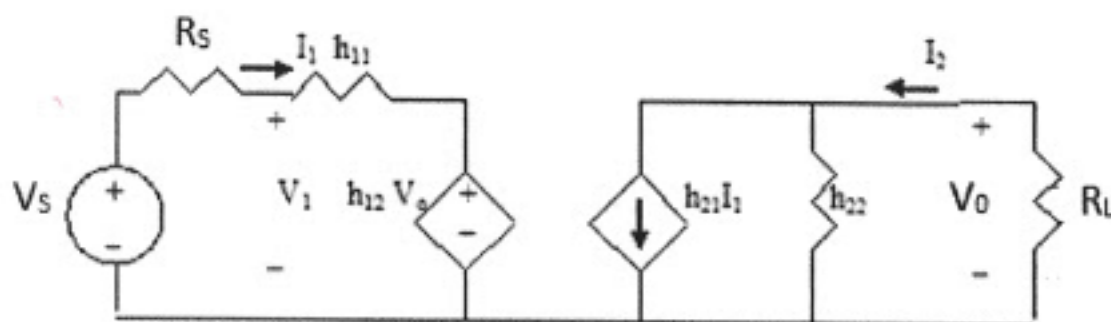
$$y_{22} = \frac{0.0278}{1/36}$$

Final Exam (A) (1/36)

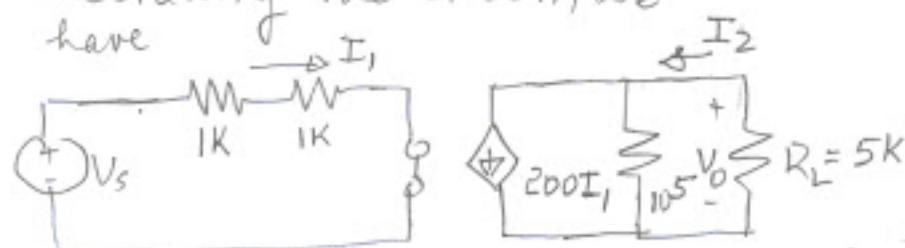
3 pts each

KEY

2. (25 points)) For the terminated two-port network with h-parameters given as: $h_{11} = 1.0 \text{ K}\Omega$, $h_{12} = 0$, $h_{21} = 200$, $h_{22} = 1 \times 10^{-5} \text{ S}$. Determine the voltage gain, V_o/V_s and current gain, I_2/I_1 . Assume that $R_s = 1 \text{ K}\Omega$, and $R_L = 5 \text{ K}\Omega$.



Redrawing the circuit, we have



Using KVL, we have

6pts $V_s = (1\text{K} + 1\text{K})I_1 = (2\text{K})I_1 \quad \dots (1)$

Using Ohm's Law, we have

6pts $V_o = -h_{21}I_1 [5\text{K} \parallel 100\text{K}]$
 $= -200I_1 \left\{ \frac{(5\text{K})(100\text{K})}{105\text{K}} \right\}$
 $= -200I_1 (4.76\text{K}) \quad \dots (2)$

Using Equations (1) and (2), we have

$$V_o = -200(4.76\text{K}) \left(\frac{V_s}{2\text{K}} \right)$$

$$\frac{V_o}{V_s} = -200 \times \frac{4.76}{2\text{K}} = -476$$

6pts

Voltage Gain = -476

$$I_2 = -\frac{V_o}{R_L}, \quad I_1 = \frac{V_s}{2\text{K}}$$

$$\frac{I_2}{I_1} = -\frac{V_o/R_L}{V_s/2\text{K}} = -\left(\frac{V_o}{V_s}\right)\left(\frac{2\text{K}}{R_L}\right)$$

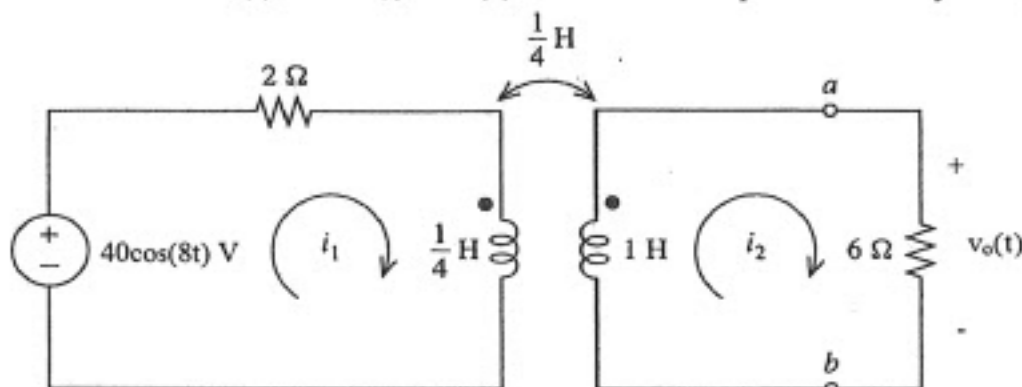
$$= -(-476)\left(\frac{2\text{K}}{5\text{K}}\right)$$

$$= \underline{190.4} \quad \boxed{7\text{pts}}$$

current gain = 190.4

KEY

3. (25 points) In the circuit shown below, (a) find $V_o(t)$, and (b) determine the impedance seen by the source.



$\omega = 8 \text{ rad/s}$

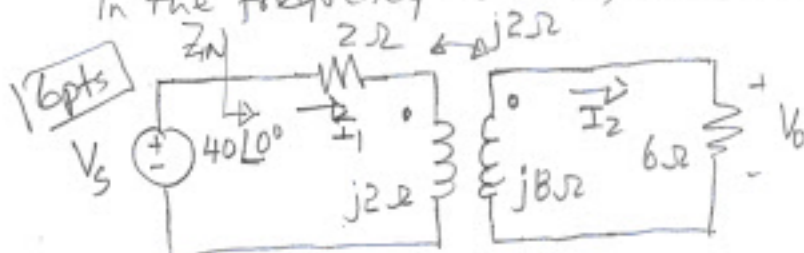
$Z_{L1} = j\omega L_1 = j(8)(\frac{1}{4}) = j2 \Omega$

$Z_{L2} = j\omega L_2 = j(8)(1) = j8 \Omega$

$Z_m = j\omega M = j(8)(\frac{1}{4}) = j2 \Omega$

$V_s = 40 \angle 0^\circ \text{ V}$

In the frequency domain, we have



Using KVL,

$40 \angle 0^\circ = (2 + j2)I_1 - j2I_2 \quad (1)$

$0 = -j2I_1 + (6 + j8)I_2 \quad (2)$

Using determinants,

$$I_1 = \frac{\begin{vmatrix} 40 & -j2 \\ 0 & (6+j8) \end{vmatrix}}{\begin{vmatrix} (2+j2) & -j2 \\ -j2 & (6+j8) \end{vmatrix}}$$

$= \frac{40(6+j8)}{(2+j2)(6+j8) - (-j2)(-j2)}$

$= \frac{40(6+j8)}{28 \angle 90^\circ} = 14.29 \angle -36.87^\circ$

$I_2 = \frac{\begin{vmatrix} (2+j2) & 40 \\ -j2 & 0 \end{vmatrix}}{28 \angle 90^\circ}$

$= \frac{-40(-j2)}{28 \angle 90^\circ} = \frac{j80}{28 \angle 90^\circ} = \frac{80}{28}$
 $= 2.86 \text{ A}$

$V_o = 6I_2 = 6(2.86) = 17.14 \angle 0^\circ$

$V_o(t) = 17.14 \cos(8t) \text{ V}$

b) Impedance seen by the source is

$Z_{IN} = \frac{V_s}{I_1} = \frac{40 \angle 0^\circ}{14.29 \angle -36.87^\circ}$

$Z_{IN} = 2.8 \angle 36.87^\circ \Omega$
 $= 2.24 + j1.68 \Omega$

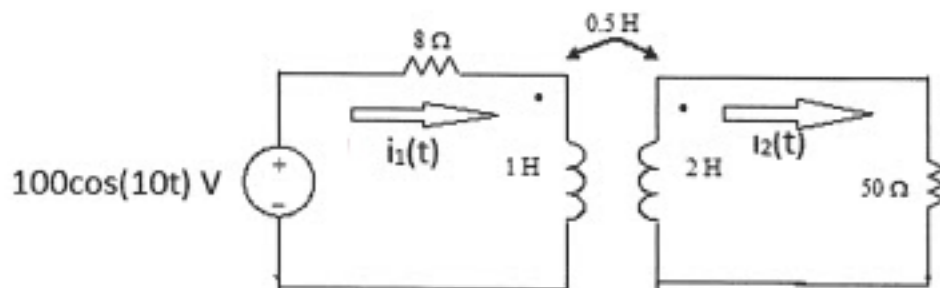
$V_o(t) = 17.14 \cos(8t)$

impedance seen by the source = $2.8 \angle 36.87^\circ = 2.24 + j1.68 \Omega$

Final Exam (A)

KEY

4. (25points) In the circuit shown below, (a) determine the currents $i_1(t)$ and $i_2(t)$



$$\omega = 10 \text{ rad/s}$$

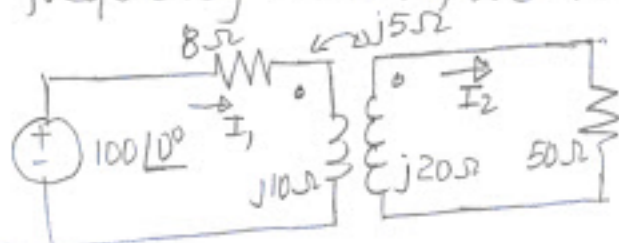
$$Z_{L1} = j(10)(1) = j10 \Omega$$

$$Z_{L2} = j(10)(2) = j20 \Omega$$

$$Z_m = j(10)(0.5) = j5 \Omega$$

$$V_s = 100 \angle 0^\circ$$

Redrawing the circuit in the frequency domain, we have



18pts Using KVL

$$100 = (8 + j10)I_1 - j5I_2$$

$$0 = -j5I_1 + (50 + j20)I_2$$

Writing in matrix form, we have

$$\begin{bmatrix} (8+j10) & -j5 \\ -j5 & (50+j20) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \end{bmatrix}$$

Using calculator to solve for I_1 and I_2 , we have

$$i_1(t) = 7.72 \cos(10t - 49.4^\circ) \text{ A}$$

6pts

$$i_2(t) = 0.72 \cos(10t + 18.8^\circ) \text{ A}$$

6pts

Final Exam (A)

$$I_1 = 7.723 \angle -49.4^\circ \text{ A}$$

$$I_2 = 0.717 \angle 18.8^\circ \text{ A}$$

Using inverse phasor transformation

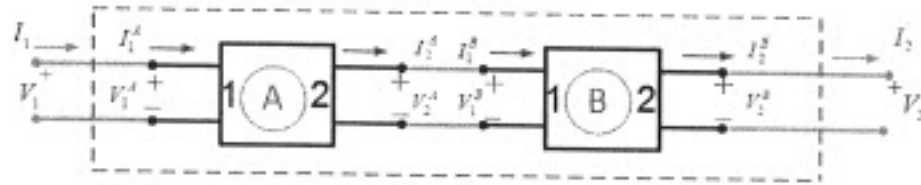
$$i_1(t) = 7.72 \cos(10t - 49.4^\circ) \text{ A}$$

$$i_2(t) = 0.72 \cos(10t + 18.8^\circ) \text{ A}$$

16
3
21

KEY

5. (13 points) Two cascaded systems is shown below. if the ABCD parameters of Network A, and B are $T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$ and $T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$, respectively. Determine the equivalent ABCD-parameters of the cascaded system.



$$T_{eq} = [T_A][T_B] = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \times 4 + 1 \times 2 & 3 \times 3 + 1 \times 5 \\ 2 \times 4 + 4 \times 2 & 2 \times 3 + 4 \times 5 \end{bmatrix} = \begin{bmatrix} 12 + 2 & 9 + 5 \\ 8 + 8 & 6 + 20 \end{bmatrix}$$

$$= \begin{bmatrix} 14 & 14 \\ 16 & 26 \end{bmatrix}$$

Answer: _____

ABOVE AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021
FINAL EXAM (A)

Excellent Work

Name: Adrian Small SID: P21368697

92+8
 ⇒ 100%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (12 points) Using the two-parameter conversion table shown below, calculate the equivalent y-parameters of a circuit whose z-parameters are given as $z_{11} = 100 \Omega$, $z_{12} = 20 \Omega$, $z_{21} = 20 \Omega$, and $z_{22} = 40 \Omega$.

Conversion of two-port parameters.

	z		y		h		g		T		t	
z	z_{11}	z_{12}	$\frac{y_{22}}{\Delta_y}$	$-\frac{y_{12}}{\Delta_y}$	$\frac{\Delta_h}{h_{22}}$	$-\frac{h_{12}}{h_{22}}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{A}{C}$	$-\frac{\Delta_T}{C}$	$\frac{d}{c}$	$-\frac{1}{c}$
	z_{21}	z_{22}	$-\frac{y_{21}}{\Delta_y}$	$\frac{y_{11}}{\Delta_y}$	$-\frac{h_{21}}{h_{22}}$	$\frac{1}{h_{22}}$	$-\frac{g_{21}}{g_{11}}$	$\frac{\Delta_g}{g_{11}}$	$\frac{1}{C}$	$-\frac{D}{C}$	$\frac{\Delta_t}{c}$	$-\frac{a}{c}$
y	$\frac{z_{22}}{\Delta_z}$	$-\frac{z_{12}}{\Delta_z}$	y_{11}	y_{12}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$-\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{a}{b}$	$-\frac{1}{b}$
	$-\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	y_{21}	y_{22}	$\frac{h_{21}}{h_{11}}$	$\frac{\Delta_h}{h_{11}}$	$-\frac{g_{21}}{g_{22}}$	$\frac{1}{g_{22}}$	$-\frac{1}{B}$	$\frac{A}{B}$	$-\frac{\Delta_t}{b}$	$\frac{d}{b}$
h	$\frac{\Delta_z}{z_{22}}$	$\frac{z_{12}}{z_{22}}$	$\frac{1}{y_{11}}$	$-\frac{y_{12}}{y_{11}}$	h_{11}	h_{12}	$\frac{g_{22}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	$\frac{B}{D}$	$\frac{\Delta_T}{D}$	$\frac{b}{a}$	$\frac{1}{a}$
	$-\frac{z_{21}}{z_{22}}$	$\frac{1}{z_{22}}$	$\frac{y_{21}}{y_{11}}$	$\frac{\Delta_y}{y_{11}}$	h_{21}	h_{22}	$-\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	$-\frac{1}{D}$	$\frac{C}{D}$	$\frac{\Delta_t}{a}$	$\frac{c}{a}$
g	$\frac{1}{z_{11}}$	$-\frac{z_{12}}{z_{11}}$	$\frac{\Delta_y}{y_{22}}$	$-\frac{y_{12}}{y_{22}}$	$\frac{h_{22}}{\Delta_h}$	$-\frac{h_{12}}{\Delta_h}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{C}{A}$	$-\frac{\Delta_T}{A}$	$\frac{c}{d}$	$-\frac{1}{d}$
	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{21}}{y_{22}}$	$\frac{1}{y_{22}}$	$-\frac{h_{21}}{\Delta_h}$	$\frac{h_{11}}{\Delta_h}$	$-\frac{g_{21}}{g_{11}}$	$\frac{g_{12}}{g_{11}}$	$\frac{1}{A}$	$\frac{B}{A}$	$\frac{\Delta_t}{d}$	$-\frac{b}{d}$
T	$\frac{z_{11}}{\Delta_z}$	$\frac{\Delta_z}{z_{21}}$	$-\frac{y_{22}}{\Delta_y}$	$-\frac{1}{\Delta_y}$	$-\frac{\Delta_h}{h_{11}}$	$\frac{1}{h_{11}}$	$\frac{g_{22}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	A	B	$\frac{d}{\Delta_t}$	$\frac{b}{\Delta_t}$
	$\frac{z_{21}}{\Delta_z}$	$\frac{\Delta_z}{z_{22}}$	$-\frac{y_{21}}{\Delta_y}$	$-\frac{y_{11}}{\Delta_y}$	$-\frac{h_{21}}{h_{11}}$	$\frac{1}{h_{11}}$	$\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	C	D	$\frac{c}{\Delta_t}$	$\frac{a}{\Delta_t}$
t	$\frac{z_{22}}{\Delta_z}$	$\frac{\Delta_z}{z_{12}}$	$-\frac{y_{11}}{\Delta_y}$	$-\frac{1}{\Delta_y}$	$\frac{1}{h_{12}}$	$\frac{h_{12}}{h_{11}}$	$-\frac{\Delta_g}{g_{12}}$	$-\frac{g_{22}}{g_{12}}$	$\frac{D}{\Delta_T}$	$\frac{B}{\Delta_T}$	a	b
	$\frac{1}{z_{12}}$	$\frac{z_{11}}{\Delta_z}$	$-\frac{y_{12}}{\Delta_y}$	$-\frac{y_{22}}{\Delta_y}$	$\frac{h_{22}}{h_{12}}$	$\frac{\Delta_h}{h_{12}}$	$-\frac{g_{11}}{g_{12}}$	$-\frac{1}{g_{12}}$	$\frac{C}{\Delta_T}$	$\frac{A}{\Delta_T}$	c	d

$$\Delta_z = z_{11}z_{22} - z_{12}z_{21} \quad \Delta_h = h_{11}h_{22} - h_{12}h_{21} \quad \Delta_T = AD - BC$$

$$\Delta_y = y_{11}y_{22} - y_{12}y_{21} \quad \Delta_g = g_{11}g_{22} - g_{12}g_{21} \quad \Delta_t = ad - bc$$

$$\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} = \begin{bmatrix} 100 & 20 \\ 20 & 40 \end{bmatrix} \Rightarrow y \begin{bmatrix} \frac{z_{22}}{\Delta_z} & -\frac{z_{12}}{\Delta_z} \\ -\frac{z_{21}}{\Delta_z} & \frac{z_{11}}{\Delta_z} \end{bmatrix} = \begin{bmatrix} \frac{40}{3600} & -\frac{20}{3600} \\ -\frac{20}{3600} & \frac{100}{3600} \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix}$$

$$\Delta_z = z_{11}z_{22} - z_{12}z_{21} \Rightarrow (100)(40) - 20(20) = 3600$$

$$\Rightarrow \begin{bmatrix} \frac{1}{90} & -\frac{1}{180} \\ -\frac{1}{180} & \frac{1}{36} \end{bmatrix}$$

$$y_{11} = \frac{1}{90}$$

$$y_{12} = -\frac{1}{180}$$

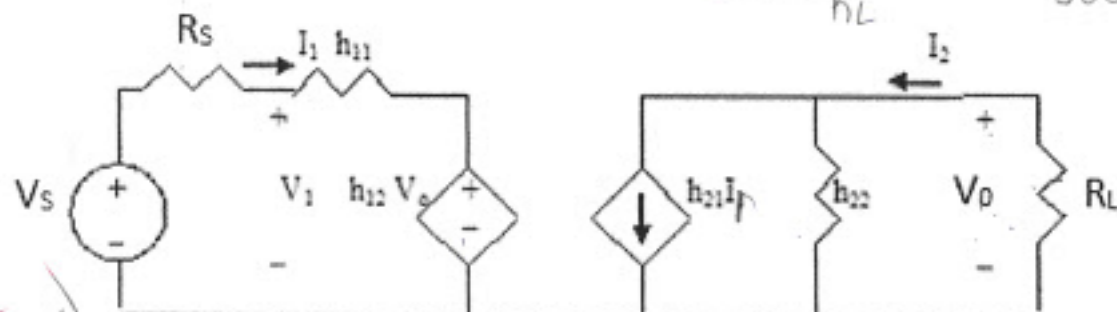
$$y_{21} = -\frac{1}{180}$$

$$y_{22} = \frac{1}{36}$$

Final Exam (A)

2. (25 points)) For the terminated two-port network with h-parameters given as: $h_{11} = 1.0 \text{ K}\Omega$, $h_{12} = 0$, $h_{21} = 200$, $h_{22} = 1 \times 10^{-5} \text{ S}$. Determine the voltage gain, V_o/V_s and current gain, I_2/I_1 . Assume that $R_s = 1 \text{ K}\Omega$, and $R_L = 5 \text{ K}\Omega$.

$$I_2 = \frac{V_o}{R_L} = \frac{-200(2\text{K})(4761.9)}{5000} = -3809.52$$



$$V_o = -h_{21} I_1 \left(\frac{1}{h_{22}} \parallel R_L \right) = -200 I_1 \left(\frac{1}{1 \times 10^{-5}} \parallel 5\text{K} \right)$$

$$\Rightarrow -200 I_1 \frac{(1 \times 10^5)(5 \times 10^3)}{(1 \times 10^5) + (5 \times 10^3)} = 4761.9$$

$$\Rightarrow -200 I_1 (4761.9)$$

$$V_s = R_s I_1 + h_{11} I_1 \Rightarrow I_1 = \frac{V_s}{R_s + h_{11}}$$

$$\Rightarrow \frac{V_s}{(1\text{K}) + (1\text{K})} = \frac{V_s}{2\text{K}}$$

$$V_s = R_s + h_{11} (I_1) \\ 1\text{K} + 1\text{K} = (2\text{K}) I_1 \\ V_s = 2\text{K} I_1$$

$$V_o = -200 I_1 (4761.9) = -200 (4761.9) \left(\frac{V_s}{2\text{K}} \right) \quad I_1 = 2 \times 10^3 \text{ A}$$

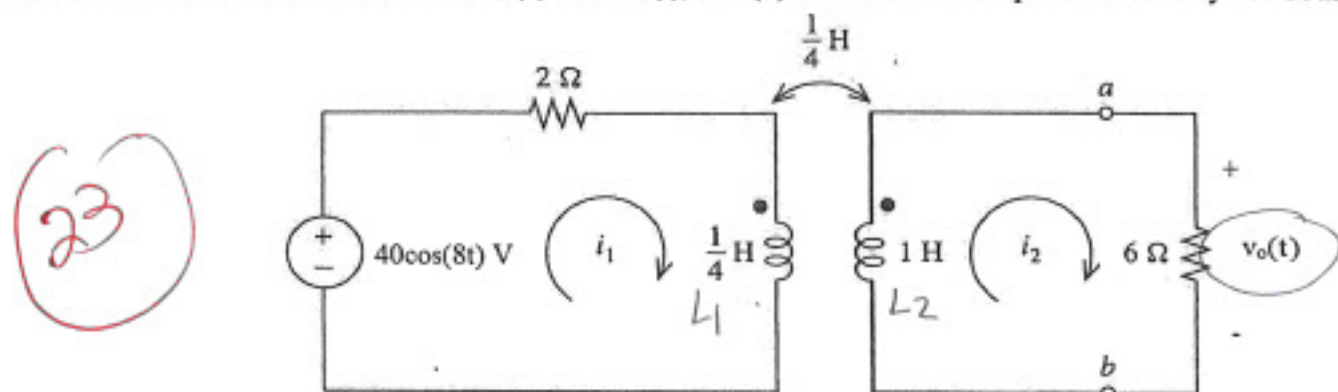
$$\frac{V_o}{V_s} = -200 \left(\frac{4761.9}{2\text{K}} \right) = -476.19$$

$$\frac{I_2}{I_1} = \frac{-3809.52}{2000}$$

Voltage Gain = -476.19

current gain = -190.476

3. (25 points) In the circuit shown below, (a) find $V_o(t)$, and (b) determine the impedance seen by the source.



$$\begin{aligned} j\omega L_1 &= j(8)\left(\frac{1}{4}\right) = j2 \quad \checkmark \\ j\omega L_2 &= j(8)(1) = j8 \\ j\omega M &= j(8)\left(\frac{1}{4}\right) = j2 \quad \checkmark \end{aligned}$$

$$V_o(t) = 6I_2$$

$$\rightarrow 2I_1 + j2I_1 - j2I_2 = 40\angle 0^\circ$$

$$j8I_2 + 6I_2 - j2I_1 = 0$$

$$(j8 + 6)I_2 = j2I_1$$

$$I_1 = \frac{(j8 + 6)}{j2} I_2 = (4 - j3)I_2$$

Substitute I_1 in $(-2I_1 \text{ and } j2I_1)$

$$\rightarrow 2(4 - j3)I_2 + j2(4 - j3)I_2 - j2I_2 = 40\angle 0^\circ$$

$$(8 - j6)I_2 + (6 + j8)I_2 - j2I_2 = 40\angle 0^\circ$$

$$I_2 = \frac{40\angle 0^\circ}{14} \Rightarrow 2.857 \text{ A}$$

$$Z_{in} = 2 + j2 + \frac{(\omega M)^2}{6 + j8}$$

$$V_o(t) = 6(2.857) = 17.142 \cos(8t) \text{ V}$$

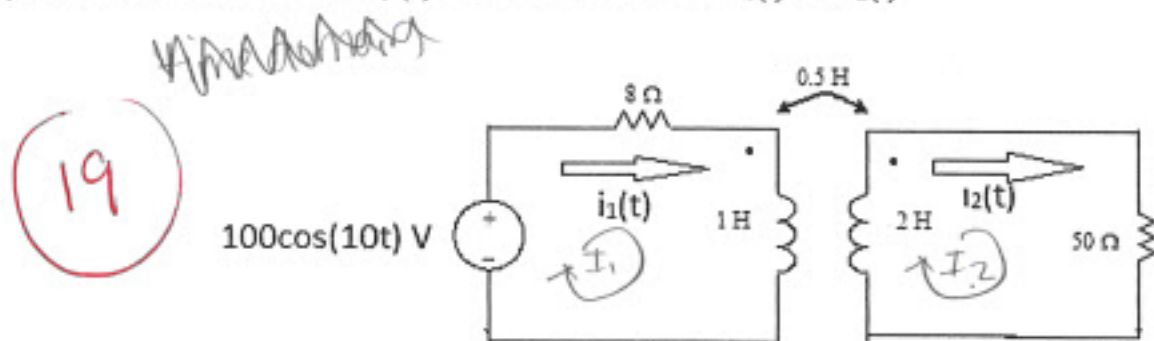
$$Z_{in} = \frac{V_s}{I_1} = \frac{40\angle 0^\circ}{?}$$

$$\Rightarrow j2 + 2 + \frac{8^2(2)^2}{6 + j8} \Rightarrow 2 + j2 + \frac{64}{(6 + j8)} = 5.84 - j3.12$$

$$V_o(t) = 17.142 \cos(8t) \text{ V}$$

$$\text{impedance seen by the source} = 6.62 - j2.11 \Omega$$

4. (25points) In the circuit shown below, (a) determine the currents $i_1(t)$ and $i_2(t)$



$$L_1 = j\omega L_1 = j(10)(1) = j10 \checkmark$$

$$L_2 = j\omega L_2 = j(10)(2) = j20 \checkmark$$

$$M = j\omega M = j(10)(0.5) = j5 \checkmark$$

$$-100 \angle 0^\circ + 8I_1 + j10I_1 - j5I_2 = 0 \quad -4$$

$$\Rightarrow 8I_1 + j10I_1 + j5I_2 = 100 \angle 0^\circ \Rightarrow (8 + j10)I_1 + j5I_2 = 100 \angle 0^\circ$$

$$j20I_2 + 50I_2 - j5I_1 = 0$$

$$(j20 + 50)I_2 = j5I_1 \Rightarrow \left(\frac{j20 + 50}{j5} \right) (0.732 \angle 14.85^\circ) \Rightarrow 7.88 \angle -53.348^\circ$$

$$I_1 = \frac{(j20 + 50)}{j5} I_2 \Rightarrow I_1 = (4 - j10) I_2$$

$$I_1(t) = 7.88 \cos(10t - 53.348^\circ)$$

$\Rightarrow$ substitute I_1 for $(8 + j10)I_1$

$$(8 + j10)(4 - j10)I_2 + j5I_2 = 100 \angle 0^\circ$$

$$(132 - j40)I_2 + j5I_2 = 100 \angle 0^\circ$$

$$132 - j35 I_2 = 100 \angle 0^\circ$$

$$I_2 = \frac{100 \angle 0^\circ}{132 - j35} = 0.732 \angle 14.85^\circ$$

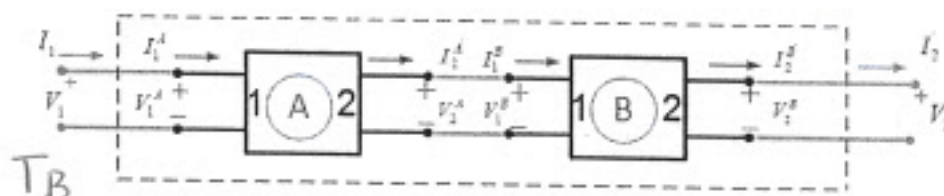
$$I_2(t) = 0.732 \cos(10t + 14.85^\circ)$$

$$i_1(t) = 7.88 \cos(10t - 53.348^\circ) \quad -1$$

$$i_2(t) = 0.732 \cos(10t + 14.85^\circ) \quad -1$$

5. (13 points) Two cascaded systems is shown below. if the ABCD parameters of Network A, and B are $T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$ and $T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$, respectively. Determine the equivalent ABCD-parameters of the cascaded system.

13



$$\begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix} = \begin{bmatrix} 14 & 14 \\ 16 & 26 \end{bmatrix} = T_{Eq}$$

Answer:

$$\begin{bmatrix} 14 & 14 \\ 16 & 26 \end{bmatrix}$$

AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021
FINAL EXAM (A)

67+8
75%

Name: Chris West SID: P21632947

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

1. (12 points) Using the two-parameter conversion table shown below, calculate the equivalent y-parameters of a circuit whose z-parameters are given as: $z_{11} = 100 \Omega$, $z_{12} = 20 \Omega$, $z_{21} = 20 \Omega$, and $z_{22} = 40 \Omega$.

Conversion of two-port parameters.

	z		y		h		g		T		t	
z	z_{11}	z_{12}	$\frac{y_{22}}{\Delta_y}$	$-\frac{y_{12}}{\Delta_y}$	$\frac{\Delta_h}{h_{22}}$	$-\frac{h_{12}}{h_{22}}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{A}{C}$	$-\frac{\Delta_T}{C}$	$\frac{d}{c}$	$-\frac{1}{c}$
	z_{21}	z_{22}	$-\frac{y_{21}}{\Delta_y}$	$\frac{y_{11}}{\Delta_y}$	$-\frac{h_{21}}{h_{22}}$	$\frac{1}{h_{22}}$	$-\frac{g_{21}}{g_{11}}$	$\frac{\Delta_g}{g_{11}}$	$\frac{1}{C}$	$-\frac{D}{C}$	$\frac{a}{c}$	$-\frac{1}{c}$
y	$\frac{z_{22}}{\Delta_z}$	$-\frac{z_{12}}{\Delta_z}$	y_{11}	y_{12}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$-\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{a}{b}$	$-\frac{1}{b}$
	$-\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	y_{21}	y_{22}	$\frac{h_{21}}{h_{11}}$	$\frac{\Delta_h}{h_{11}}$	$-\frac{g_{21}}{g_{22}}$	$\frac{1}{g_{22}}$	$-\frac{1}{B}$	$\frac{A}{B}$	$-\frac{\Delta_T}{b}$	$\frac{d}{b}$
h	$\frac{\Delta_z}{z_{22}}$	$\frac{z_{12}}{z_{22}}$	$\frac{1}{y_{11}}$	$-\frac{y_{12}}{y_{11}}$	h_{11}	h_{12}	$\frac{g_{12}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	$\frac{B}{D}$	$\frac{\Delta_T}{D}$	$\frac{b}{a}$	$\frac{1}{a}$
	$-\frac{z_{21}}{z_{22}}$	$\frac{1}{z_{22}}$	$\frac{y_{21}}{y_{11}}$	$\frac{\Delta_y}{y_{11}}$	h_{21}	h_{22}	$-\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	$-\frac{1}{D}$	$\frac{C}{D}$	$\frac{\Delta_T}{a}$	$\frac{c}{a}$
g	$\frac{1}{z_{11}}$	$-\frac{z_{12}}{z_{11}}$	$\frac{\Delta_y}{y_{22}}$	$-\frac{y_{12}}{y_{22}}$	$\frac{h_{22}}{\Delta_h}$	$-\frac{h_{12}}{\Delta_h}$	$\frac{g_{11}}{g_{21}}$	$-\frac{g_{12}}{g_{21}}$	$\frac{A}{C}$	$-\frac{\Delta_T}{A}$	$\frac{c}{d}$	$-\frac{1}{d}$
	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{21}}{y_{22}}$	$\frac{1}{y_{22}}$	$-\frac{h_{21}}{\Delta_h}$	$\frac{h_{11}}{\Delta_h}$	$\frac{g_{21}}{g_{21}}$	$\frac{g_{22}}{g_{21}}$	$\frac{1}{A}$	$\frac{B}{A}$	$\frac{\Delta_T}{d}$	$-\frac{b}{d}$
T	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{22}}{y_{21}}$	$-\frac{1}{y_{21}}$	$-\frac{\Delta_h}{h_{21}}$	$-\frac{h_{11}}{h_{21}}$	$\frac{1}{g_{21}}$	$\frac{g_{22}}{g_{21}}$	A	B	$\frac{d}{\Delta_T}$	$\frac{b}{\Delta_T}$
	$\frac{1}{z_{21}}$	$\frac{z_{22}}{z_{21}}$	$-\frac{\Delta_y}{y_{21}}$	$-\frac{y_{11}}{y_{21}}$	$-\frac{h_{22}}{h_{21}}$	$-\frac{1}{h_{21}}$	$\frac{g_{11}}{g_{21}}$	$\frac{\Delta_g}{g_{21}}$	C	D	$\frac{c}{\Delta_T}$	$\frac{a}{\Delta_T}$
t	$\frac{z_{22}}{z_{12}}$	$\frac{\Delta_z}{z_{12}}$	$-\frac{y_{11}}{y_{12}}$	$-\frac{1}{y_{12}}$	$\frac{1}{h_{12}}$	$\frac{h_{11}}{h_{12}}$	$-\frac{\Delta_g}{g_{12}}$	$-\frac{g_{22}}{g_{12}}$	$\frac{D}{\Delta_T}$	$\frac{B}{\Delta_T}$	a	b
	$\frac{1}{z_{12}}$	$\frac{z_{11}}{z_{12}}$	$-\frac{y_{22}}{y_{12}}$	$-\frac{y_{21}}{y_{12}}$	$\frac{h_{22}}{h_{12}}$	$\frac{\Delta_h}{h_{12}}$	$-\frac{g_{11}}{g_{12}}$	$-\frac{1}{g_{12}}$	$\frac{C}{\Delta_T}$	$\frac{A}{\Delta_T}$	c	d

$$\Delta_z = z_{11}z_{22} - z_{12}z_{21}, \quad \Delta_h = h_{11}h_{22} - h_{12}h_{21}, \quad \Delta_T = AD - BC$$

$$\Delta_y = y_{11}y_{22} - y_{12}y_{21}, \quad \Delta_g = g_{11}g_{22} - g_{12}g_{21}, \quad \Delta_t = ad - bc$$

$$Y = \begin{bmatrix} \frac{z_{22}}{\Delta_z} & -\frac{z_{12}}{\Delta_z} \\ -\frac{z_{21}}{\Delta_z} & \frac{z_{11}}{\Delta_z} \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} \frac{40}{360} & -\frac{20}{360} \\ -\frac{20}{360} & \frac{100}{360} \end{bmatrix}$$

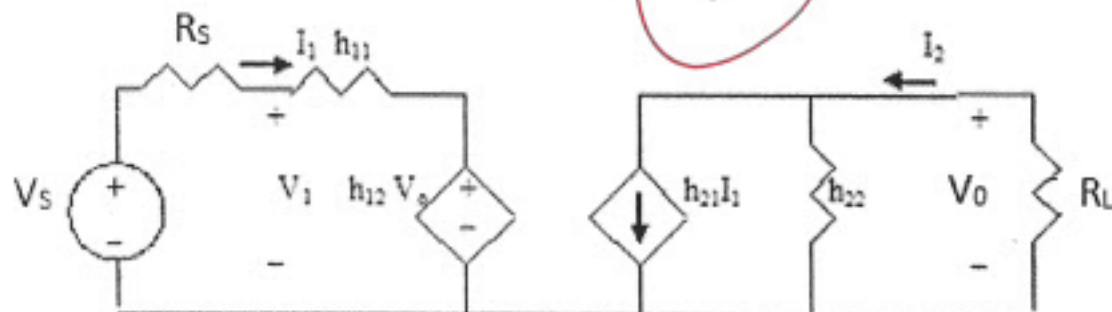
$$= \begin{bmatrix} 1/90 & -1/180 \\ -1/180 & 1/36 \end{bmatrix}$$

$y_{11} = \frac{1}{90} \Omega$ $y_{12} = -\frac{1}{180} \Omega$ $y_{21} = -\frac{1}{180} \Omega$ $y_{22} = \frac{1}{36} \Omega$

Final Exam (A)

2. (25 points)) For the terminated two-port network with h-parameters given as: $h_{11} = 1.0 \text{ K}\Omega$, $h_{12} = 0$, $h_{21} = 200$, $h_{22} = 1 \times 10^{-5} \text{ S}$. Determine the voltage gain, V_o/V_s and current gain, I_2/I_1 . Assume that $R_s = 1 \text{ K}\Omega$, and $R_L = 5 \text{ K}\Omega$.

6



$$Z_{eq} = \frac{h_{22} \times R_L}{h_{22} + R_L} = \frac{1 \times 10^{-5} \times 5000}{1 \times 10^{-5} + 5000} = \frac{5 \times 10^{-9}}{5000} = 10^{-7}$$

$$-h_{21}Z_i \times Z_{eq}$$

$$-h_{21}Z_i \times 10^{-7}$$

$$-V_s + I_1 R_s + h_{11} I_1 = 0$$

For the output,
use Ohm's Law

$$I_2 (2000) = V_s =$$

$$\frac{V_s}{2000} = I_1$$

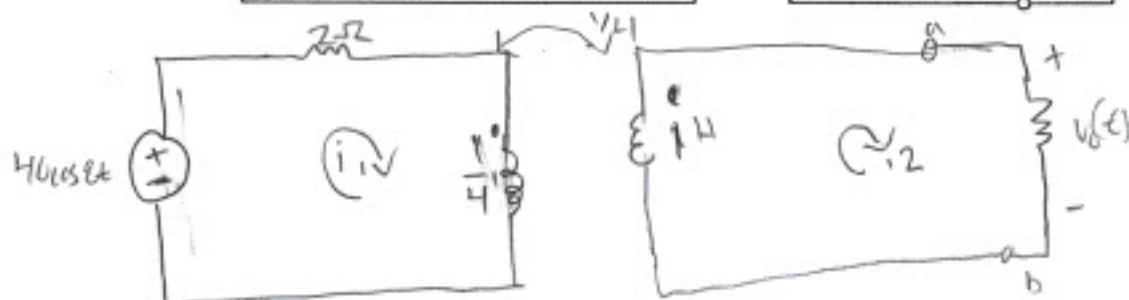
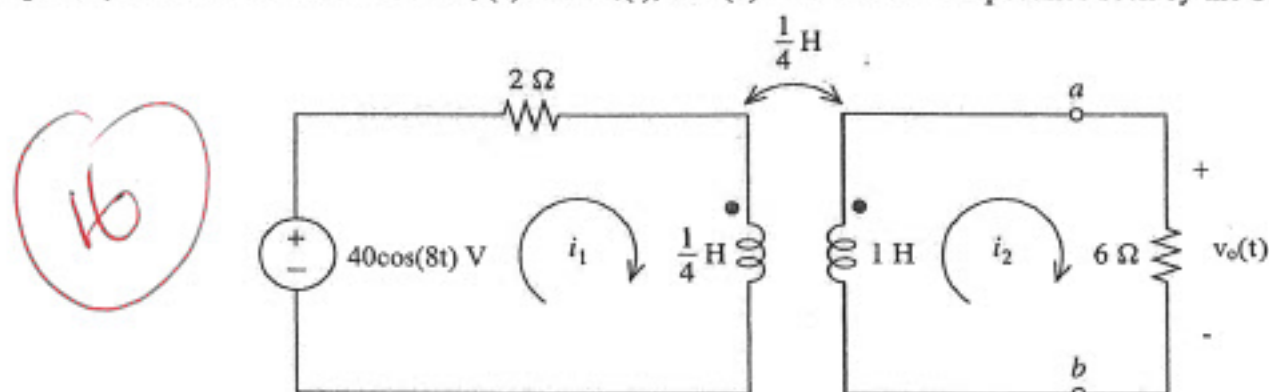
$$V_o = -200 \times \frac{V_s}{2000} \times 10^{-7}$$

$$\frac{V_o}{V_s} = -100 \times 10^{-7} = \text{current gain}$$

Voltage Gain = ~~_____~~

current gain = ~~_____~~

3. (25 points) In the circuit shown below, (a) find $V_o(t)$, and (b) determine the impedance seen by the source.



$$40 \angle 0^\circ = 2I_1 + I_1 \cdot \frac{j\omega L}{4} - j\omega M I_2$$

$$40 \angle 0^\circ = I_1 (2 + j2) - (j0.25) I_2$$

$$j0.25 I_1 = j\omega I_2 + 6 I_2$$

$$I_2 = I_1 \frac{j0.25}{6 + j6}$$

$$I_2 = I_1 \frac{j0.25 \angle 90^\circ}{36.86^\circ} = I_1 \angle 34.86^\circ$$

$$40 \angle 0^\circ = I_1 (2 + j2) - (j0.25 \times 2) \angle 34.86^\circ$$

$$40 \angle 0^\circ = I_1 2.831 \angle 44.86^\circ$$

$$I_1 = 14.13 \angle -44.86^\circ \text{ A}$$

$$Z_1 = \frac{V_s}{I_1} = \frac{40 \angle 0^\circ}{14.13 \angle -44.86^\circ} = 2.831 \angle 44.86^\circ \Omega$$

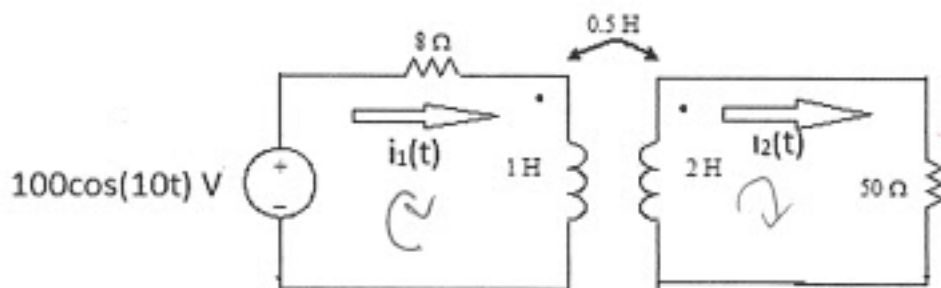
$$Z_1 = 2 + j2 = 2.831 \angle 44.86^\circ \Omega$$

$$V_o(t) = \text{---} \angle -4 \text{---}$$

$$\text{impedance seen by the source} = \text{---} \text{---}$$

4. (25points) In the circuit shown below, (a) determine the currents $i_1(t)$ and $i_2(t)$

~~20~~
21



$$\omega \times M = 0.5 \times 10 = 5 \Omega \checkmark$$

$$X_{L1} = \omega L_1 = 10 \times 1 = 10 \Omega \checkmark$$

$$X_{L2} = \omega L_2 = 10 \times 2 = 20 \Omega \checkmark$$

1(VL

$$50(i_2(t)) + j20 \times i_2(t) - j5 \cdot (t) i_1 = 0$$

loop $i_2(t)$

$$i_2(t)(j20 + 50) = [i_1(t) = -i_1(t) \cdot (-j5)] + i_2(t)(j20 + 50) = 0$$

$$\frac{100}{\sqrt{2}} \angle 0^\circ + 2 \times i_1(t) \angle 10^\circ - j5 \cdot i_2(t) = 0$$

$$i_1(t) [0 + j10] - i_2(t) (j5) = \frac{100}{\sqrt{2}} \angle 0^\circ$$

loop $i_1(t)$

$$j(-4.141 + 1) + 3.55 = i_1$$

$$= 5.4562$$

$$i_2 = 0.418 + 0.501635 = 0.5071$$

$$\angle 18.85^\circ$$

$$\angle 47.41^\circ$$

$$i_1 = 5.4562 \cos(\omega t - 47.41^\circ) \text{ A}$$

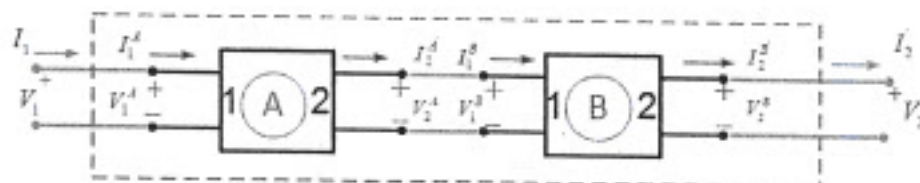
$$i_2 = 0.5071 \cos(\omega t + 18.85^\circ) \text{ A}$$

$i_1(t) =$ _____

$i_2(t) =$ _____

5. (13 points) Two cascaded systems is shown below. if the ABCD parameters of Network A, and B are $T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$ and $T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$, respectively. Determine the equivalent ABCD-parameters of the cascaded system.

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$$T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$$

$$T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$$

$$T = T_A \times T_B$$

$$= \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$$

$$T = \begin{bmatrix} 14 & 14 \\ 16 & 20 \end{bmatrix}$$

Answer:

$T = \begin{bmatrix} 14 & 14 \\ 16 & 20 \end{bmatrix}$

BELOW AVERAGE

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
FALL 2021
FINAL EXAM (A)

Name: Keithan Rose SID: 921542922

41+8
 ⇒ 49%

Note: All the steps that lead to your answer should be shown. In addition, put answers in blanks provided.

(12 points) Using the two-parameter conversion table shown below, calculate the equivalent y-parameters of a circuit whose z-parameters are given as: $z_{11} = 100 \Omega$, $z_{12} = 20 \Omega$, $z_{21} = 20 \Omega$, and $z_{22} = 40 \Omega$.

Conversion of two-port parameters.

	z		y		h		g		T		t	
z	z_{11}	z_{12}	$\frac{y_{22}}{\Delta_z}$	$-\frac{y_{12}}{\Delta_z}$	$\frac{\Delta_h}{h_{22}}$	$-\frac{h_{12}}{h_{22}}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{A}{C}$	$-\frac{\Delta_T}{C}$	$\frac{d}{c}$	$-\frac{1}{c}$
	z_{21}	z_{22}	$-\frac{y_{21}}{\Delta_z}$	$\frac{y_{11}}{\Delta_z}$	$-\frac{h_{21}}{h_{22}}$	$\frac{1}{h_{22}}$	$\frac{g_{21}}{g_{11}}$	$-\frac{\Delta_g}{g_{11}}$	$\frac{1}{C}$	$-\frac{D}{C}$	$\frac{\Delta_t}{c}$	$-\frac{a}{c}$
y	$\frac{z_{22}}{\Delta_z}$	$-\frac{z_{12}}{\Delta_z}$	y_{11}	y_{12}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$-\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{a}{b}$	$-\frac{1}{b}$
	$\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	y_{21}	y_{22}	$\frac{h_{21}}{h_{11}}$	$\frac{\Delta_h}{h_{11}}$	$-\frac{g_{21}}{g_{22}}$	$\frac{1}{g_{22}}$	$-\frac{1}{B}$	$\frac{A}{B}$	$-\frac{\Delta_t}{b}$	$\frac{d}{b}$
h	$\frac{\Delta_z}{z_{22}}$	$\frac{z_{12}}{z_{22}}$	$\frac{1}{y_{11}}$	$-\frac{y_{12}}{y_{11}}$	h_{11}	h_{12}	$\frac{g_{22}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	$\frac{B}{D}$	$\frac{\Delta_T}{D}$	$\frac{b}{a}$	$\frac{1}{a}$
	$\frac{z_{21}}{z_{22}}$	$\frac{1}{z_{22}}$	$\frac{y_{21}}{y_{11}}$	$\frac{\Delta_y}{y_{11}}$	h_{21}	h_{22}	$-\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	$-\frac{1}{D}$	$\frac{C}{D}$	$\frac{\Delta_t}{a}$	$\frac{c}{a}$
g	$\frac{1}{z_{11}}$	$-\frac{z_{12}}{z_{11}}$	$\frac{\Delta_y}{y_{22}}$	$-\frac{y_{12}}{y_{22}}$	$\frac{h_{22}}{\Delta_h}$	$-\frac{h_{12}}{\Delta_h}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{C}{A}$	$-\frac{\Delta_T}{A}$	$\frac{c}{d}$	$-\frac{1}{d}$
	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{21}}{y_{22}}$	$\frac{1}{y_{22}}$	$-\frac{h_{21}}{\Delta_h}$	$\frac{h_{11}}{\Delta_h}$	$\frac{g_{21}}{g_{11}}$	$-\frac{\Delta_g}{g_{11}}$	$\frac{1}{A}$	$\frac{B}{A}$	$\frac{\Delta_t}{d}$	$-\frac{b}{d}$
T	$\frac{z_{11}}{z_{21}}$	$\frac{\Delta_z}{z_{21}}$	$-\frac{y_{22}}{y_{21}}$	$-\frac{1}{y_{21}}$	$-\frac{\Delta_h}{\Delta_z}$	$-\frac{h_{11}}{\Delta_z}$	$\frac{1}{g_{21}}$	$-\frac{g_{12}}{g_{21}}$	A	B	$\frac{d}{\Delta_y}$	$\frac{b}{\Delta_z}$
	$\frac{1}{z_{21}}$	$\frac{z_{22}}{z_{21}}$	$-\frac{\Delta_y}{y_{21}}$	$-\frac{y_{11}}{y_{21}}$	$-\frac{h_{22}}{\Delta_z}$	$-\frac{1}{\Delta_z}$	$\frac{g_{11}}{g_{21}}$	$-\frac{\Delta_g}{g_{21}}$	C	D	$\frac{c}{\Delta_z}$	$\frac{a}{\Delta_z}$
t	$\frac{z_{22}}{z_{12}}$	$\frac{\Delta_z}{z_{12}}$	$-\frac{y_{11}}{y_{12}}$	$-\frac{1}{y_{12}}$	$\frac{1}{h_{12}}$	$\frac{h_{11}}{h_{12}}$	$-\frac{g_{12}}{g_{12}}$	$-\frac{g_{22}}{g_{12}}$	$\frac{D}{\Delta_T}$	$\frac{B}{\Delta_T}$	a	b
	$\frac{1}{z_{12}}$	$\frac{z_{11}}{z_{12}}$	$-\frac{\Delta_y}{y_{12}}$	$-\frac{y_{22}}{y_{12}}$	$\frac{h_{22}}{h_{12}}$	$\frac{\Delta_h}{h_{12}}$	$-\frac{g_{11}}{g_{12}}$	$-\frac{1}{g_{12}}$	$\frac{C}{\Delta_T}$	$\frac{A}{\Delta_T}$	c	d

$\Delta_z = z_{11}z_{22} - z_{12}z_{21}$
 $\Delta_y = y_{11}y_{22} - y_{12}y_{21}$
 $\Delta_h = h_{11}h_{22} - h_{12}h_{21}$
 $\Delta_g = g_{11}g_{22} - g_{12}g_{21}$
 $\Delta_T = AD - BC$
 $\Delta_t = ad - bc$

$y_{11} = \Delta_z / z_{22}$
 $y_{12} = z_{12} / z_{22}$
 $y_{22} = 1 / z_{22}$
 $y_{21} = -z_{21} / z_{22}$

$\Delta_z = (100)(40) - (20)(20)$
 $\Delta_z = 4000 - 400 = 3600$

$y_{11} = \frac{z_{22}}{\Delta_z} = \frac{40}{3600} = 0.011$

$y_{21} = \frac{-z_{21}}{\Delta_z} = \frac{-20}{3600} = -0.00556$

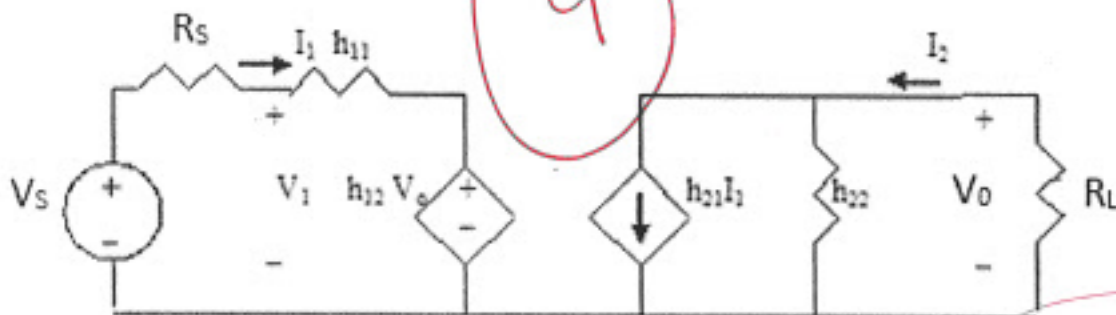
$y_{12} = \frac{z_{12}}{\Delta_z} = \frac{20}{3600} = 0.00556$

$y_{22} = \frac{1}{\Delta_z} = \frac{1}{3600} = 0.0002778$

$z_{11} = 100 \Omega$
 $z_{12} = 20 \Omega$
 $z_{21} = 20 \Omega$
 $z_{22} = 40 \Omega$

$y_{11} = 0.011$ ✓
 $y_{12} = 0.00556$ ✓
 $y_{21} = -0.00556$ ✓
 $y_{22} = 0.0002778$ ✓
 Final Exam (A)

- ② (25 points)) For the terminated two-port network with h-parameters given as: $h_{11} = 1.0 \text{ K}\Omega$, $h_{12} = 0$, $h_{21} = 200$, $h_{22} = 1 \times 10^{-5} \text{ S}$. Determine the voltage gain, V_o/V_s and current gain, I_2/I_1 . Assume that $R_s = 1 \text{ K}\Omega$, and $R_L = 5 \text{ K}\Omega$.



Determine voltage gain, V_o/V_s

Current Gain, I_2/I_1

$$\frac{h_{22} \times R_L}{h_{22} + R_L} = \frac{1 \times 10^{-5} \cdot 5000}{5000 + (1 \times 10^{-5})} = \frac{.05}{5000.0001}$$

$$Z_{eq} = 9.999 \times 10^{-6}$$

-3

$$V_o = -h_{21} \times I_1 \times Z_{eq} \quad V_o = -h_{21} I_1 \times (10 \times 10^{-6}) \quad [5k || 100k] = Z_{eq}$$

$$-V_s + I_1 R_s + I_1 h_{11} = 0$$

$$V_s = I_1 (1000 + 1000)$$

$$I_1 = \frac{V_s}{2000}$$

$$V_o = -200 \times 10^{-7}$$

$$-200 \times \frac{V_s}{2000} \times 10^{-7}$$

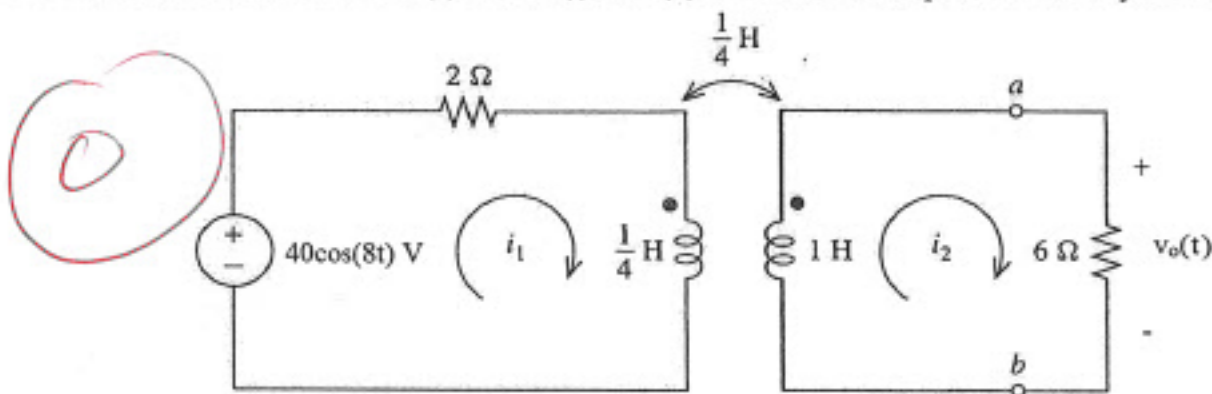
$$1 \times 10^{-8}$$

$$V_o/V_s = -10^{-8}$$

$$\text{Voltage Gain} = \frac{-1 \times 10^{-8}}{1}$$

$$\text{current gain} = \frac{I_2}{I_1}$$

- ③ (25 points) In the circuit shown below, (a) find $V_o(t)$, and (b) determine the impedance seen by the source.



Find $V_o(t)$

$$L_1 = 1/4 \text{ H}, L_2 = 1 \text{ H}$$

$$M = 1/4 \text{ H}$$

$$M = K\sqrt{L_1 L_2} \rightarrow K = \frac{M}{\sqrt{L_1 L_2}}$$

$$K = \frac{1/4}{\sqrt{1/4}} \rightarrow K = 1/2$$

$$V_1 = 40\cos(8t) \text{ V}$$

$$V_2 = V_o(t) = M \frac{di_1}{dt} + L_2 \frac{di_2}{dt}$$

$$V = IR \rightarrow I = V/R$$

$$I_1 = \frac{40\cos(8t)}{2 + j2.5}$$

$$V_2 = j\omega M I_1 + j\omega L_2 I_2$$

$$j.25 I_1 + j I_2 = V_o(t)$$

Determine the impedance

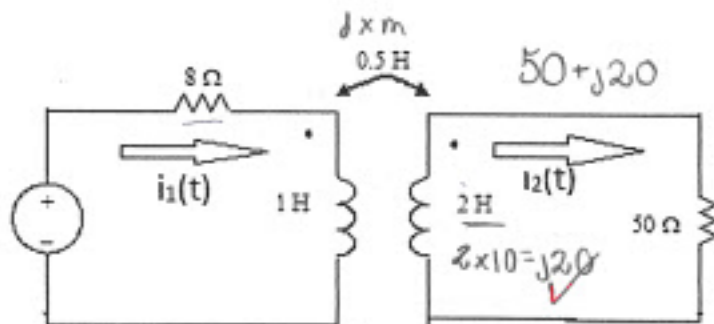
$$V_o(t) =$$

$$\text{impedance seen by the source} =$$

⌘ (25points) In the circuit shown below, (a) determine the currents $i_1(t)$ and $i_2(t)$

7

$$100\cos(10t) \text{ V}$$



Find $i_1(t)$ and $i_2(t)$

$$X_m = \omega \times M = 10 \times 0.5 = 5 \Omega$$

$$X_{L1} = \omega \times L_1 = 10 \times 1 = 10 \Omega$$

$$X_{L2} = \omega \times L_2 = 2 \times 10 = 20 \Omega$$

Loop 2 KVL 50

$$(8 + j20)(50 - j5) - j10i_2 =$$

$$\frac{400 - j40 + j1000 - 100}{j10} = \frac{j10i_2}{j10}$$

$$i_2 = \frac{300 + j960}{j10} = 96 - j30$$

$$= 100.58 \angle -30.3^\circ$$

$$i_1 = (50 - j5)i_2$$

$$i_1 = (50 - j5)(96 - j30)$$

$$i_1 = 4800 - j1500 - j480 + 150 = 4950 - j1980$$

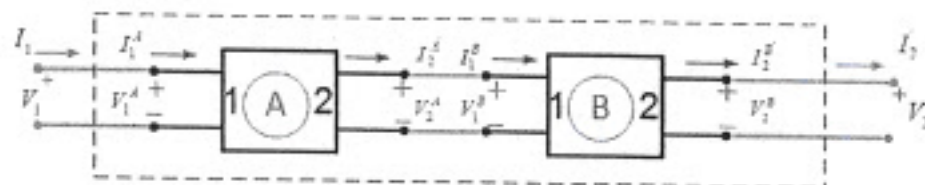
$$4950 - j1980 = 5331.31 \angle -38.1^\circ$$

$$i_1(t) = 5331.31 \angle -38.1^\circ$$

$$i_2(t) = 100.58 \angle -30.3^\circ$$

⚡ (13 points) Two cascaded systems is shown below. if the ABCD parameters of Network A, and B are $T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$ and $T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$, respectively. Determine the equivalent ABCD-parameters of the cascaded system.

13



Equivalent ABCD parameters

$$T_A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$$

$$T_B = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \times 4 + 2 \times 1 & 1 \times 5 + 3 \times 3 \\ 2 \times 1 + 4 \times 2 & 4 \times 5 + 3 \times 2 \end{bmatrix} = \begin{bmatrix} 14 & 14 \\ 10 & 26 \end{bmatrix}$$

XL

XR

Answer:

$$\begin{bmatrix} 14 & 14 \\ 10 & 26 \end{bmatrix}$$

**NETWORK THEORY II SEMESTER PROJECT
FALL 2021**

COMPUTER ASSIGNMENT

TOPICS COVERED IN COMPUTER ASSIGNMENT

- 1. Zeros of a Transfer Function**
- 2. Determining Transfer Function of a Circuit**
- 3. Applications of MATLAB**
- 4. Frequency Response Plots**

**NETWORK THEORY II
COMPUTER ASSIGNMENT
FALL 2021**

COMPUTER ASSIGNMENT QUESTIONS

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ELEG 3301-P01 NETWORK THEORY II
COMPUTER ASSIGNMENT / FALL 2021

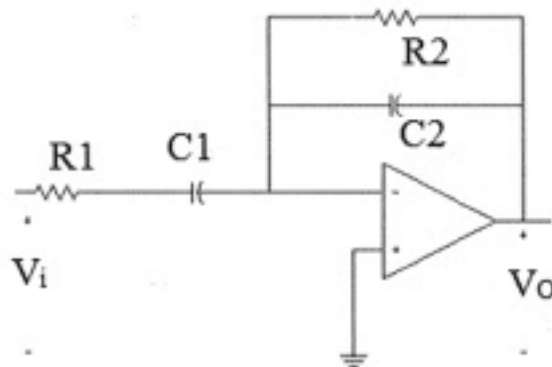
Due Date: Wednesday, November 10, 2021

1. The transfer function of a filter is as: $H(s) = \frac{s^2 + 16.0 \times 10^8}{s^2 + 26.0 \times 10^8 s + 16.0 \times 10^8}$

- (a) Use MATLAB to determine the zeros of $H(s)$
- (b) Use MATLAB to plot the magnitude response.
- (c) Determine the center frequency.
- (d) What type of filter is represented by the transfer function $H(s)$?

2. For Figure shown below, $R_1 = R_2 = 1.0 \text{ K}\Omega$, $C_1 = 100 \text{ }\mu\text{F}$, and $C_2 = 0.001 \text{ }\mu\text{F}$,

- (a) Find the transfer function $H(s) = \frac{V_o(s)}{V_i(s)}$.
- (b) Use MATLAB to plot the magnitude characteristics.
- (c) Determine the center frequency.
- (d) Find the bandwidth of the filter.



**NETWORK THEORY II
FALL 2021**

DETAILED COMPUTER ASSIGNMENT GRADING SCHEME

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
NETWORK THEORY II – ELEG 3301 -P01
FALL 2021

COMPUTER ASSIGNMENT
GRADING SHEET

NAME OF STUDENT: _____

ITEMS	POINTS ACHIEVED	MAXIMUM POINTS
Problem 1		10
MATLAB program for zeros and magnitude response		
Problem 1 (a) Zeros of $H(s)$		10
Problem 1 (b) Magnitude Response		10
Problem 1 (c) Determination of Center Frequency		5
Problem 1 (d) Type of Filter		5
Problem 2 (a) Determining the transfer function $H(s)$		20
Problem 2 MATLAB program for magnitude response		10
Problem 2 (b) Magnitude Response		10
Problem 2 (c) Determination of Center frequency		10
Problem 2 (d) Determination of Bandwidth of Filter		10

ELEG 3301-P01
COMPUTER ASSIGNMENT

SOLUTION

Problem 1

MATLAB Program

```
%  
% Magnitude response of a transfer function  
num = [ 1 0 16.0e8]; % coefficients of numerator polynomial  
zeros = roots(num)  
den = [1 26.0e8 16.0e8]; % coefficients of denominator polynomial  
poles = roots(den)  
w = logspace (-2, 10); % range of frequencies  
hs = freqs(num, den, w);  
f = w/(2*pi); % frequency in Hz.  
hs_mag = 20*log10(abs(hs)); % Magnitude in decibels  
% Plot the magnitude response  
semilogx(f, hs_mag)  
title ('Magnitude Response')  
xlabel('Frequency, Hz')  
ylabel('Magnitude, dB')
```

Answer:

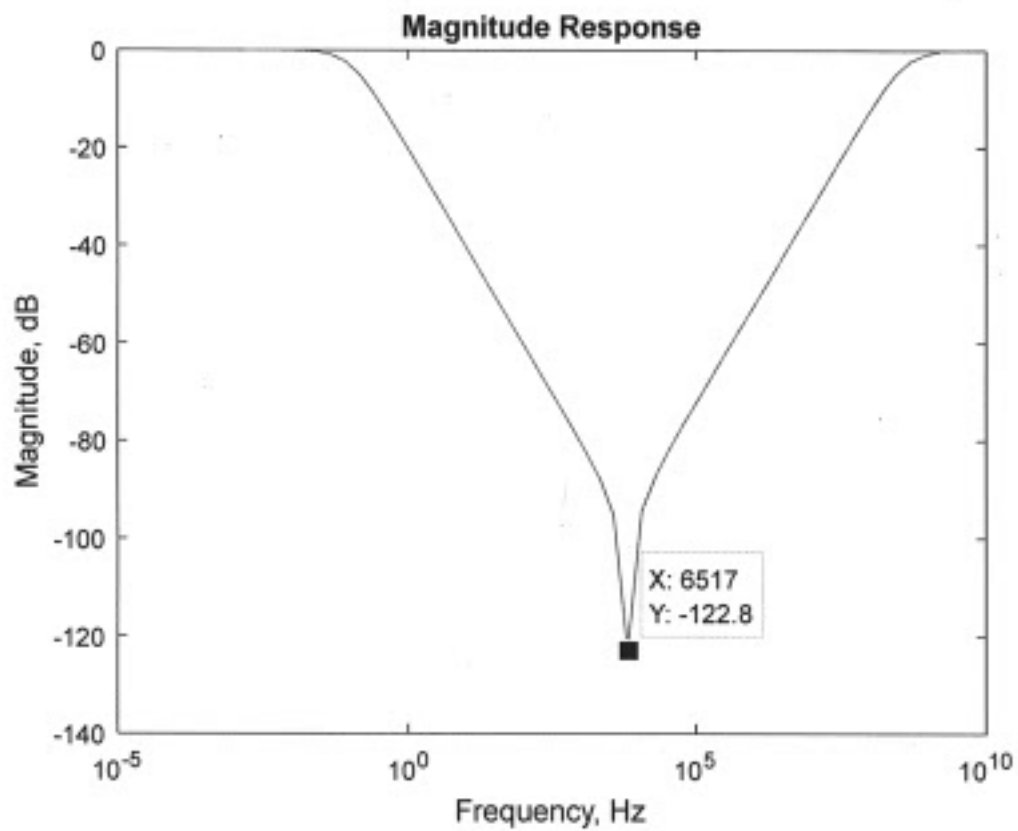
>> e3301_pr1

zeros =

1.0e+04 *

0.0000 + 4.0000i

0.0000 - 4.0000i

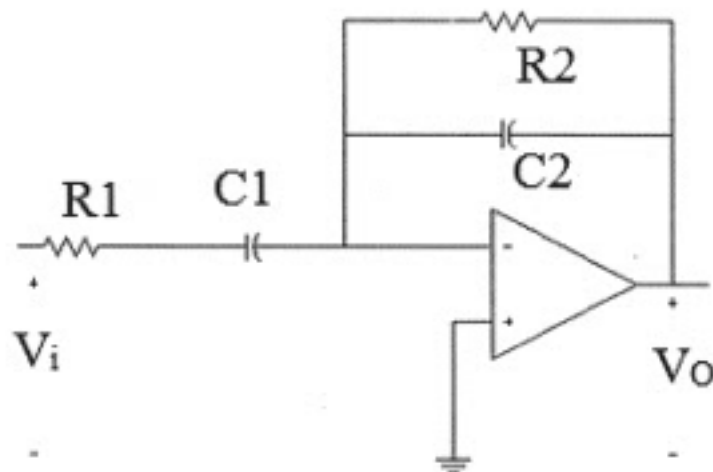


(c) Center frequency = 6517 Hz

(d) The filter with the transfer function $H(s)$ is a band-stop filter.

Problem 2

Circuit:



The transfer function is derived as follows:

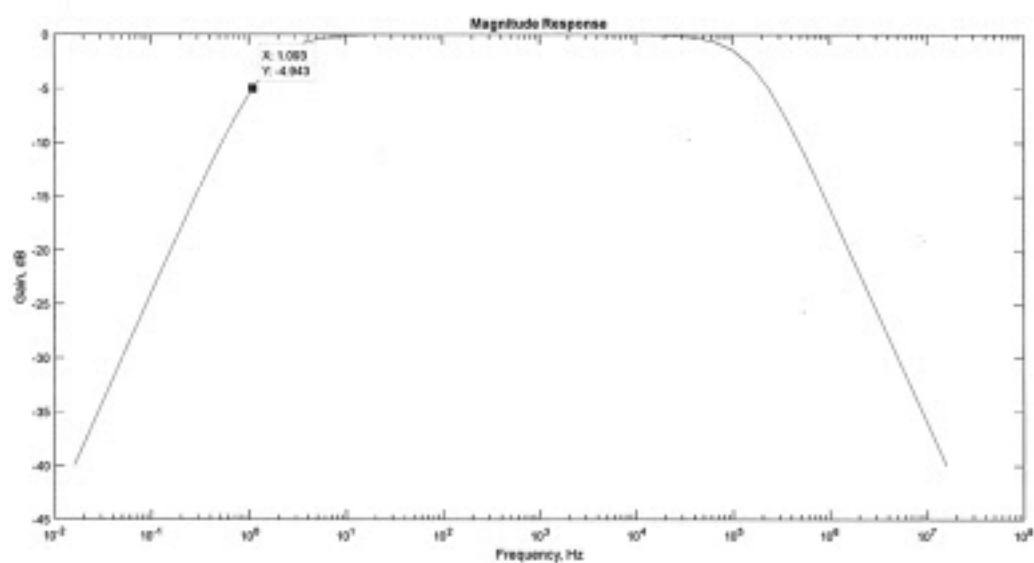
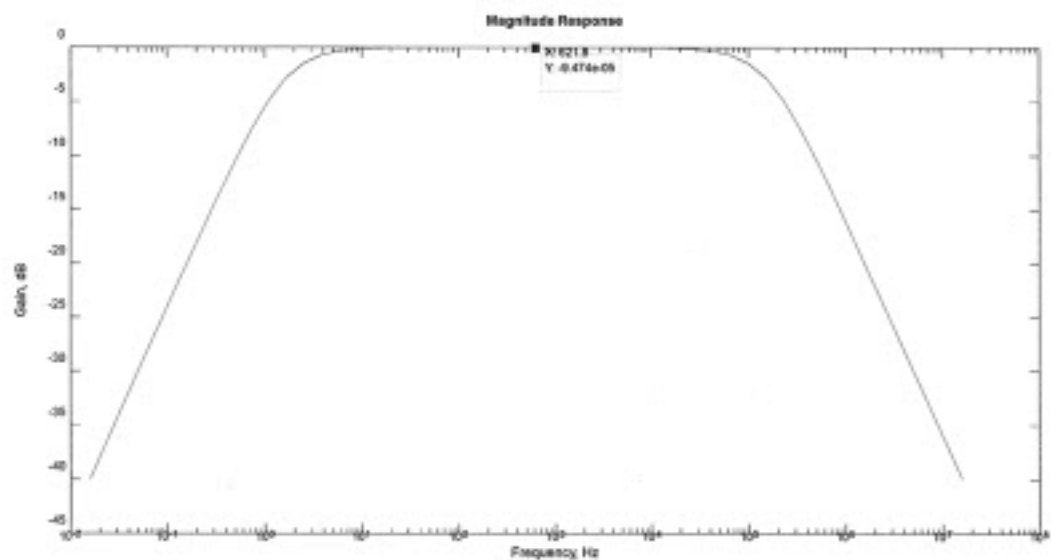
$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{-R2 \parallel \frac{1}{sC2}}{R1 + \frac{1}{sC1}} = \frac{\frac{-R2}{1 + sC2R2}}{\frac{1 + sC1R1}{sC1}}$$

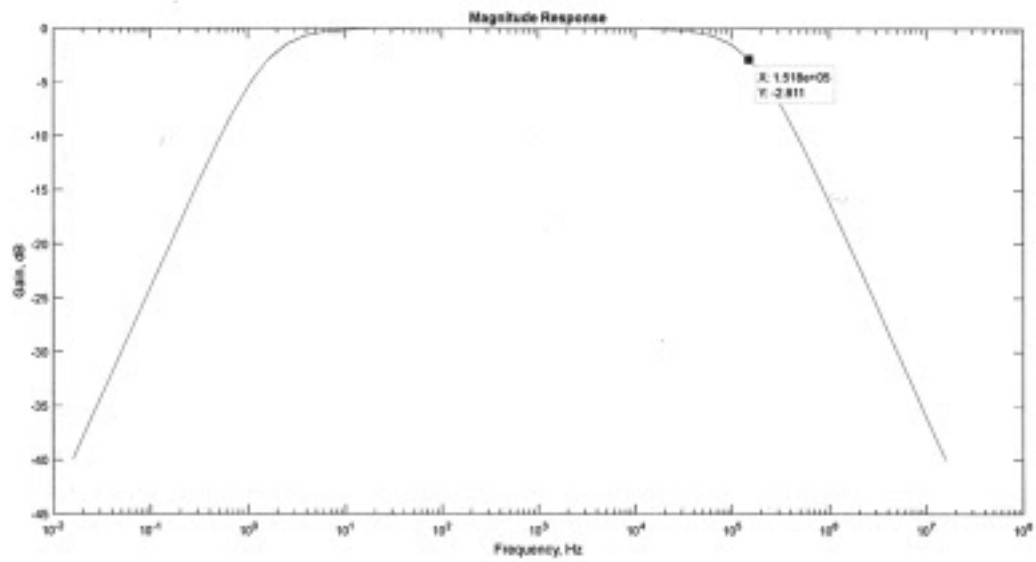
$$H(s) = \frac{-R2C1s}{(1 + sC2R2)(1 + sC1R1)} = \frac{-R2C1s}{s^2C2R2C1R1 + s(C2R2 + C1R1) + 1} \text{ or}$$

$$H(s) = \frac{-R2C1s}{s^2C2R2C1R1 + s(C2R2 + C1R1) + 1}$$

(b) MATLAB Program

```
% Problem #2, Fall 2020 - ELEG 3013-202
c1 = 100e-6;
c2 = 0.001e-6;
r1 = 1.0e3;
r2 = 1.0e3;
a1 = c1*r2;
b0 = 1.0;
b1 = (c2*r2 + c1*r1);
b2 = c1*c2*r1*r2;
num = [-a1 0];
den = [b2 b1 b0];
w = logspace(-1, 8);
h = freqs(num, den, w);
f = w/(2*pi);
mag = 20*log10(abs(h));
semilogx(f, mag)
title('Magnitude Response')
xlabel('Frequency, Hz')
ylabel('Gain, dB')
```

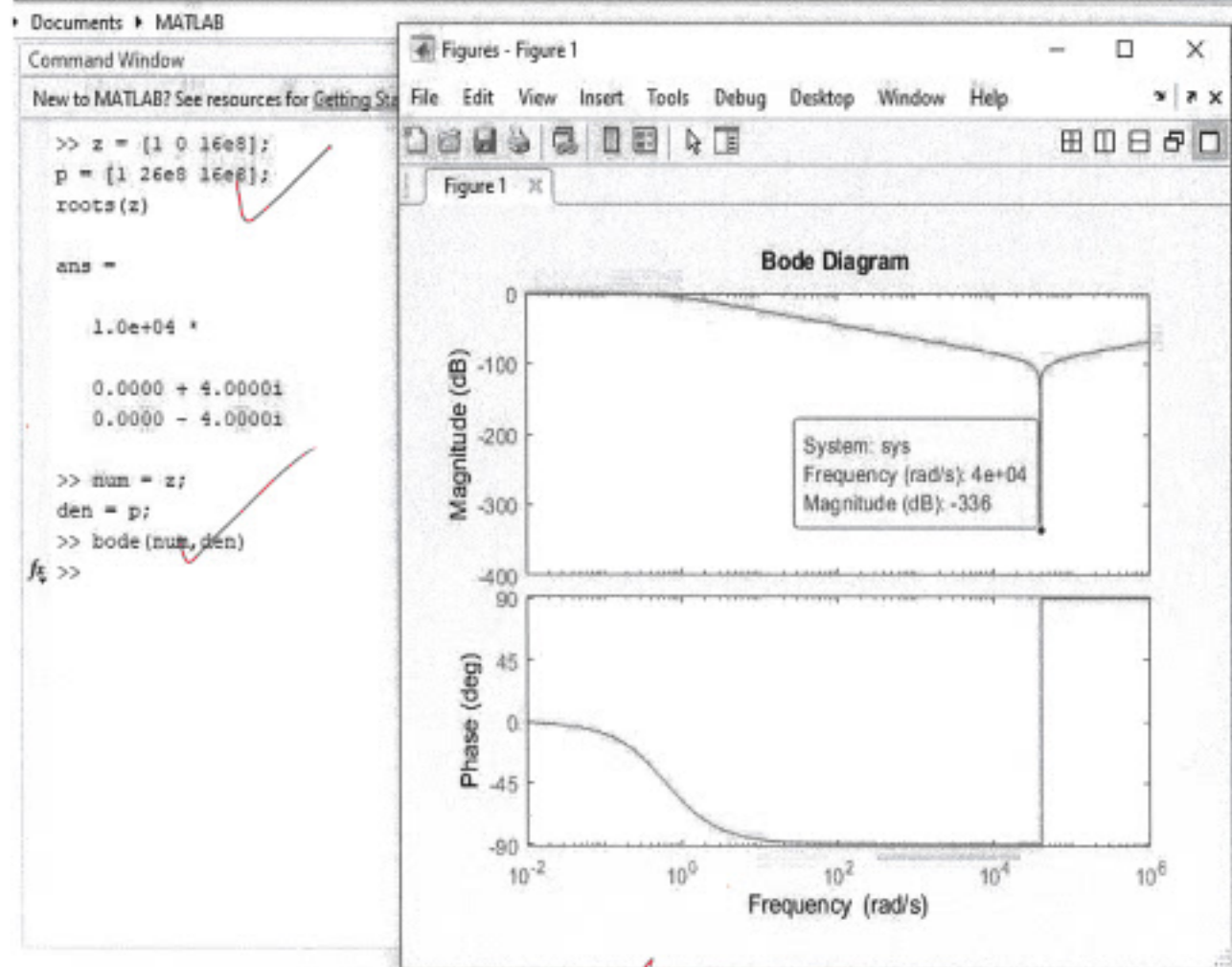




Center frequency = 621.8 Hz

Bandwidth = $1.518e5 - 1.67 \text{ Hz} = 1.51e5 \text{ Hz}$

**ABOVE AVERAGE
COMPUTER ASSIGNMENT**

MATLAB Computer Assignment

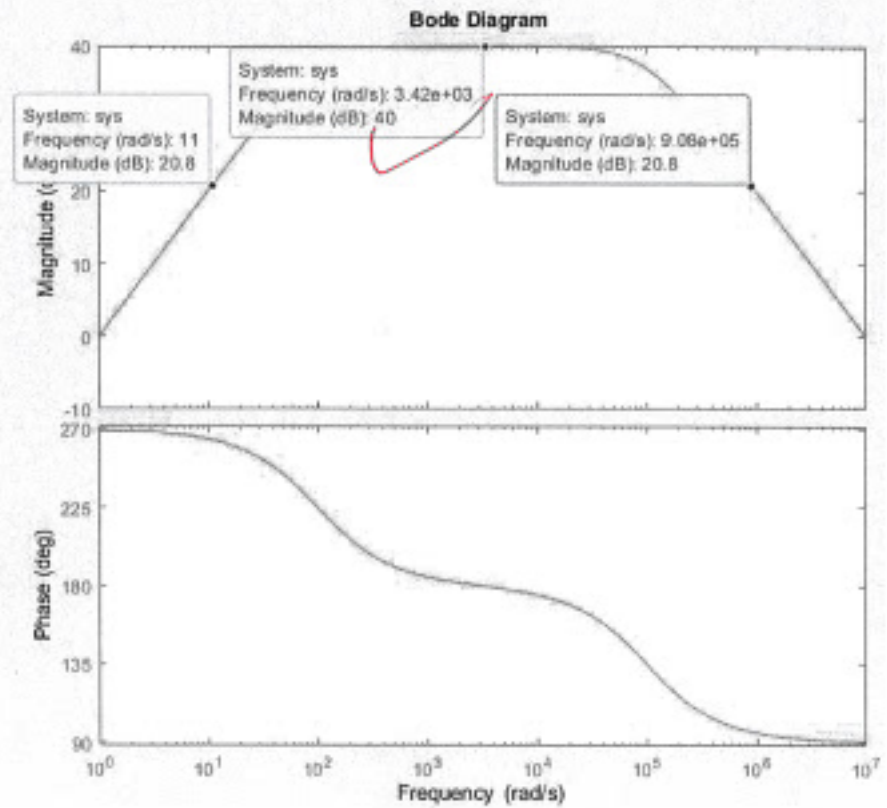
- The zeros of $H(s)$ are $1.0e+04$, $+4i$, and $-4i$ ✓
- Magnitude response is -336dB ✓
- Center Frequency is $4e+04\text{ rad/s}$ ✓
- This is a band reject filter ✓

Part 2

```

Save Open Variable Workspace Clear Workspace Favorite
VARIABLE
Drive Documents MATLAB
Command Window
New to MATLAB! See resources for Getting Started
>> num = [-1e7 0];
>> den = [1 100010 1e7];
>> bode(num,den)
f_s >>

```



a. (Answer on the next page)

b. Magnitude is 40 dB ✓

c. Center Frequency is 4.5e+05 rad/s ✗

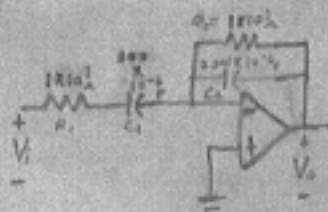
d. Bandwidth is 9.08e+05 rad/s ✓

Center frequency incorrect

Jarrod Ballou

$s = j\omega$

$$\frac{V_i(s)}{R_1 + \frac{1}{C_1 s}} + \frac{-V_o(s)}{R_2} + \frac{-V_o(s)}{\frac{1}{C_2 s}} = 0$$



$$\left[\frac{1}{1000} + \frac{1}{(1\mu F)(10^{-6})s} \right] V_o(s) = - \left[\frac{1}{1000 + (1\mu F)(10^{-6})s} \right] V_i(s)$$

$$\left[\frac{1 + 10^{-6}s}{1000} \right] V_o(s) = - \left[\frac{10^{-6}s}{1 + 0.1s} \right] V_i(s)$$

$$\frac{V_o(s)}{V_i(s)} = \frac{-0.1s}{(1 + 0.1s)(1 + 10^{-6}s)}$$

$$\frac{V_o(s)}{V_i(s)} = \frac{-1 \times 10^6 s}{(s + 10)(s + 10^6)}$$

a)
$$\frac{V_o(s)}{V_i(s)} = \frac{-1 \times 10^6 s}{s^2 + 1000010 s + 1 \times 10^8}$$

c)
$$\omega_n = \frac{\omega_1 + \omega_2}{2} = \frac{9.08 \times 10^5 + 11}{2} = 4.5 \times 10^5 \text{ rad/s}$$

d)
$$BW = \omega_2 - \omega_1 = \omega_H - \omega_L$$

$$= 9.08 \times 10^5 - 11$$

$$BW = 9.08 \times 10^5 \text{ rad/s}$$

**AVERAGE
COMPUTER ASSIGNMENT**

Net Theory 2 Computer Assignment

70/100
Terrell Gray

```

Editor - Untitled2.m
1 - num = [1 0 16e8];
2 - den = [1 32e8 16e8];
3 - h=tf(num,den);
4 -
5 - s = zero(h);
6 - disp(s);
7 -
8 - bode(h)

Command Window
0.0000 + 4.0000i
0.0000 - 4.0000i

>> 206111e02
1.0e+04 *

0.0000 + 4.0000i
0.0000 - 4.0000i
    
```

1. R >> |

The Zeros of the function are
1.0e+04

0.0000 + 4.0000i
0.0000 - 4.0000i

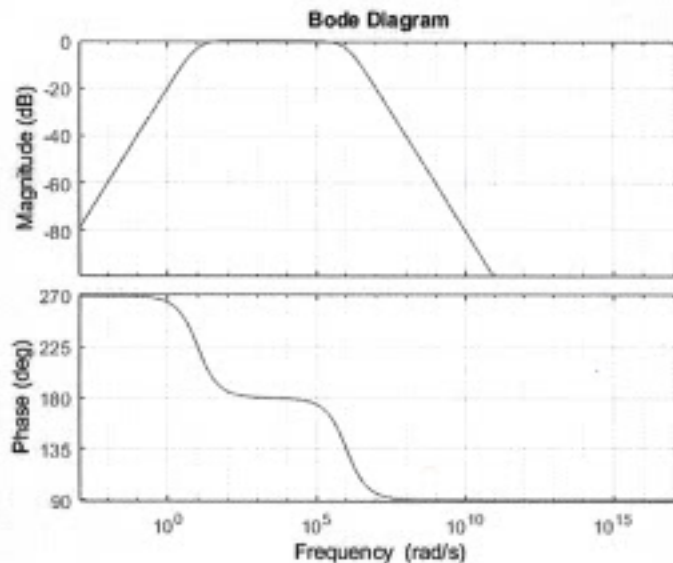


2.

3. $\omega_c = \sqrt{16 \cdot 10^8} = 40000 \text{ rad/s}$

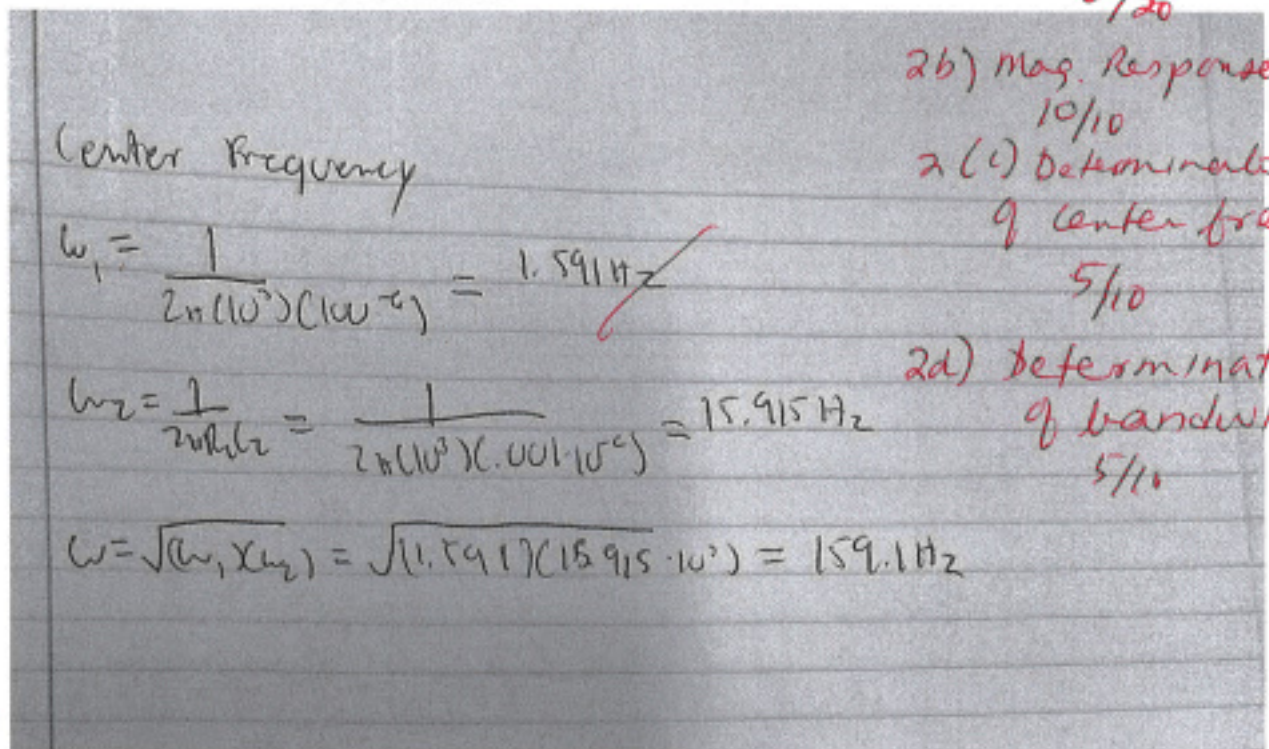
4. Due to the bode diagram we can state that the filter is a band-reject, as the magnitude is decreasing until the cut off frequency and increasing after the cut off frequency.

1. $H(s) = .1s \div (1 * 10^{-6}s^2 + .10001s + 1)$



You did not derive
the transfer function
-20

2.



2) MATLAB 10/10
2(a) Transfer function
0/20

2b) Mag. Response
10/10
2(c) Determination
of center freq.
5/10

2d) Determination
of bandwidth
5/10

3.

$$B = \frac{R}{L} = \frac{\omega_0}{Q} = \omega_0^2 CR$$

$$\begin{aligned} \omega_{BW} &= \omega_H - \omega_L \\ &= 100200 - 9.971 \text{ ~~rad/s~~} \\ &= 100190.029 \text{ rad/s} \end{aligned}$$

$$BW_{Hz} = \frac{BW}{2\pi} = \frac{100190.029}{2\pi} = 15995.738 \text{ Hz}$$

4.

The bandwidth and center frequencies are incorrect.

BELOW AVERAGE
COMPUTER ASSIGNMENT

Ivan Coronado

Network Theory II

ELEG 3301 – PO1 CRN : 17524

62%

Dr. John Attia

Computer Assignment

11-03-21

1. The transfer function of a filter is as: $H(s) = \frac{s^2 + 16.0 \times 10^8}{s^2 + 26.0 \times 10^8 s + 16.0 \times 10^8}$

- Use MATLAB to determine the zeros of $H(s)$
- Use MATLAB to plot the magnitude response.
- Determine the center frequency.
- What type of filter is represented by the transfer function $H(s)$?

MATLAB Script

```
clc;
clear;
close all;
b = [1, 0, 16e6]; % Numerator coefficients
a = [1, 26e6, 16e6]; % Denominator Coefficients
Hs = tf(b, a);
disp('The poles of H(s) are at: ');
P = pole(Hs)
disp('The zeros of H(s) are at: ');
Z = zero(Hs)
After executing we get
The poles of H(s) are at:
P =
1.0e+07 *
-2.6000
-0.0000
The zeros of H(s) are at:
Z =
1.0e+03 *
0.0000 + 4.0000i
0.0000 - 4.0000i
>>
```

should be 16×10^8

21/40

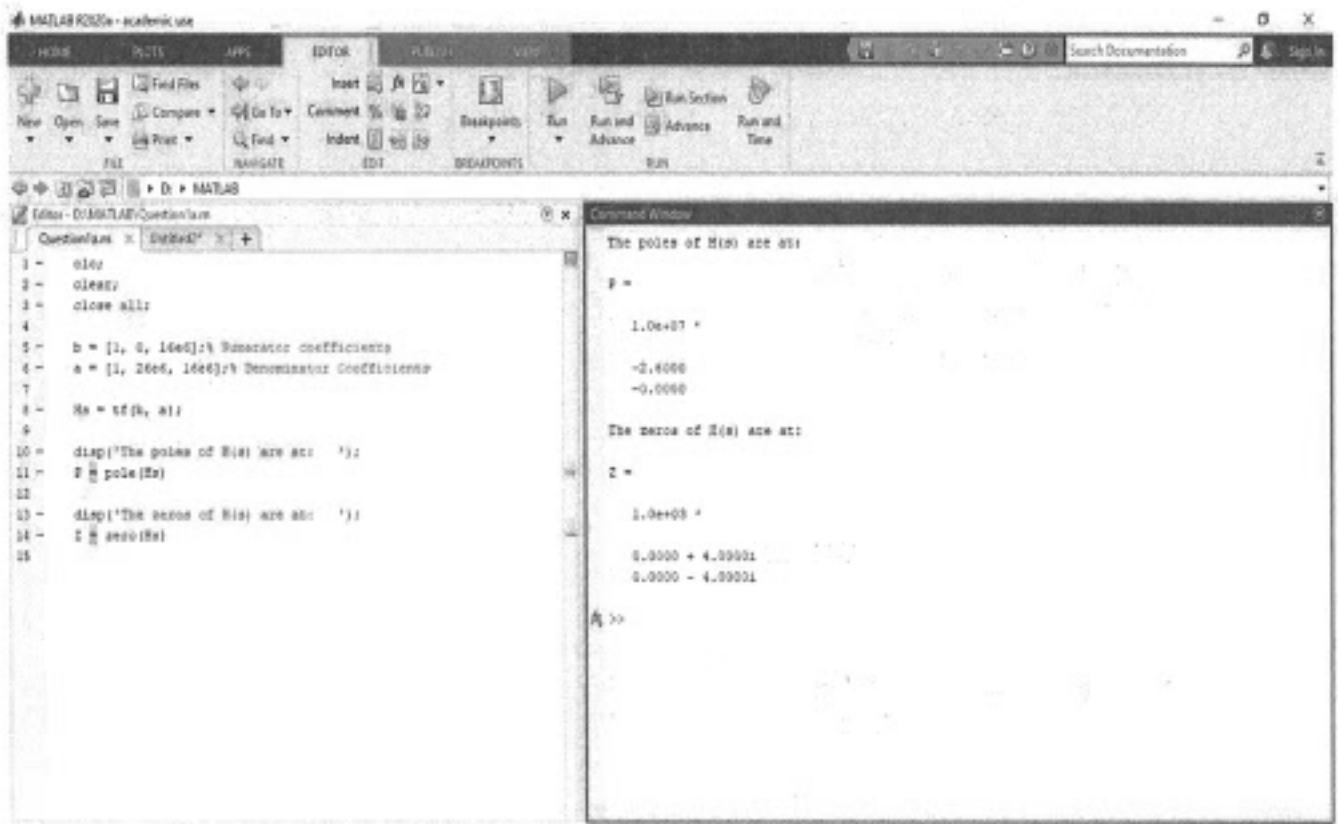
1a) 5/10

1b) 0/10

1c) 3/5

1d) 0/5

1-MATLAB 5/10



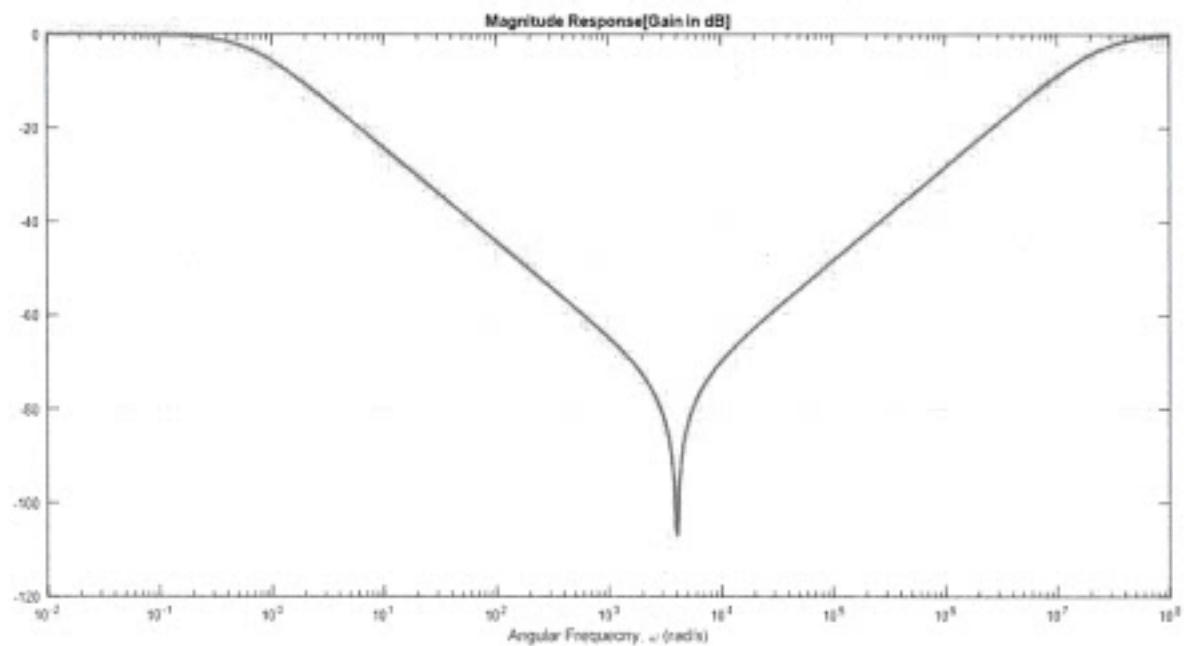
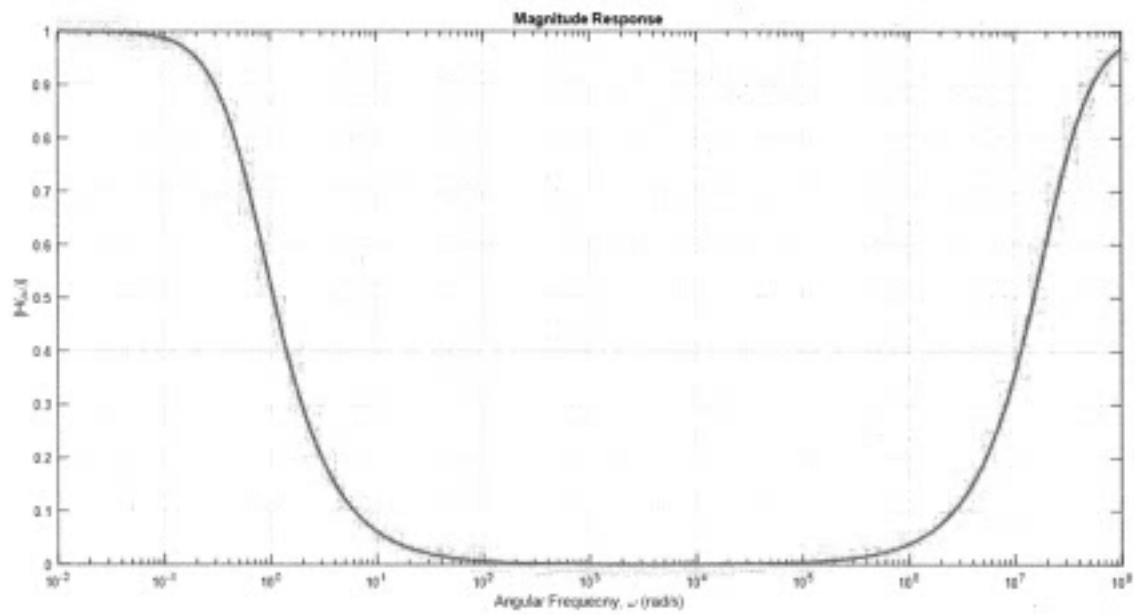
MATLAB Script

```

clc;
clear;
close all;
b = [1, 0, 16e6]; % Numerator coefficients
a = [1, 26e6, 16e6]; % Denominator Coefficients
[H, w] = freqs(b, a);
M = abs(H);
M_dB = 20*log10(M);
figure
semilogx(w, M, 'linewidth', 2);
grid;
xlabel('Angular Frequency, \omega (rad/s)');
ylabel(' |H(\omega)| ');
title('Magnitude Response');
figure
semilogx(w, M_dB, 'linewidth', 2);
grid;
xlabel('Angular Frequency, \omega (rad/s)');
ylabel(' Gain in dB ');
title('Magnitude Response[Gain in dB]');

```

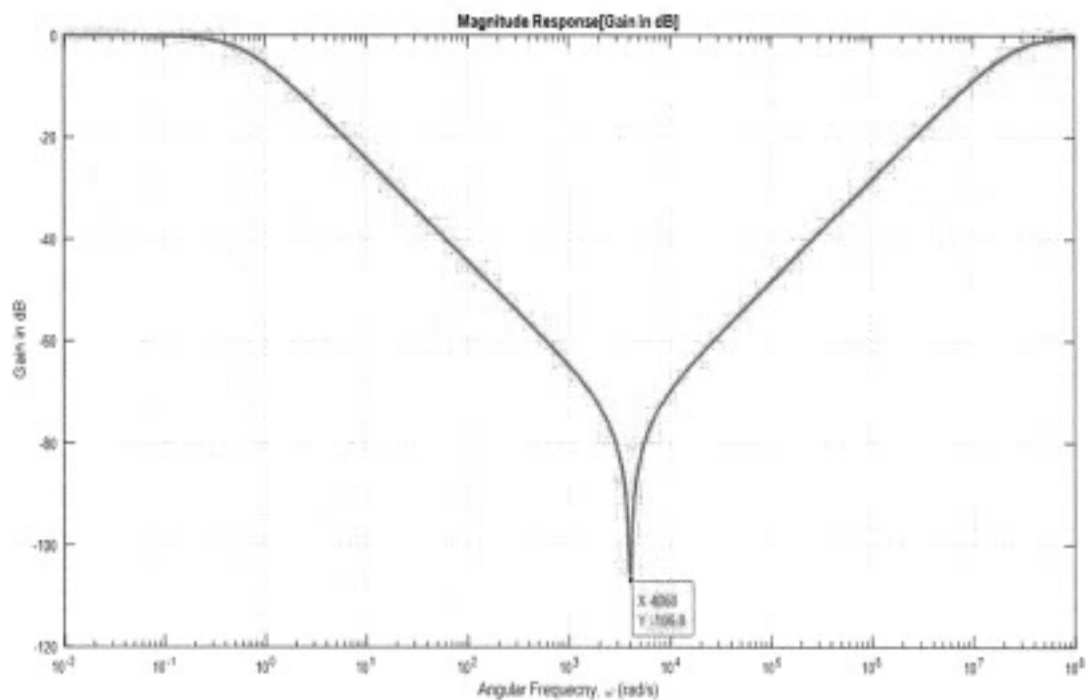
After executing we get



the type of filter was not given

Question 1(c)

To determine the center frequency we will find the point which corresponds to the minimum dB. This point is marked in the figure below



So the center frequency is

$$\omega_0 = 4060 \text{ rad/s}$$

Center frequency in Hz will be

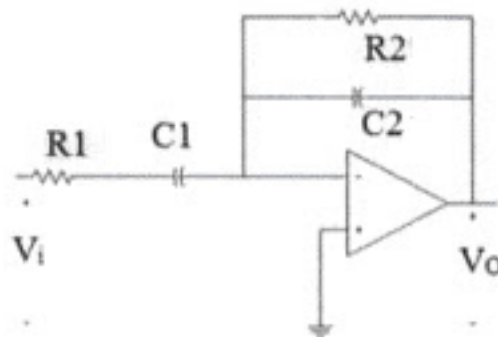
$$f_o = \frac{\omega_0}{2\pi}$$

$$f_o = \frac{4060}{2\pi}$$

$$f_o = 646.169 \text{ Hz}$$

2. For Figure shown below, $R_1 = R_2 = 1.0 \text{ K}\Omega$, $C_1 = 100 \mu\text{F}$, and $C_2 = 0.001 \mu\text{F}$.

- Find the transfer function $H(s) = \frac{V_o(s)}{V_i(s)}$.
- Use MATLAB to plot the magnitude characteristics.
- Determine the center frequency.
- Find the bandwidth of the filter.



```
clear;
clc;
close all;
syms s w;
r1 = 1000;
r2 = 1000;
c1 = 100*10^-6;
c2 = 0.001*10^-6;
H = s*c1*r2/(1+s*r1*c1)/(1+s*c2*r2);
Hw = subs(H,s,1i*w);
fplot(20*log10(abs(Hw)),[-2*10^6 2*10^6],'linewidth',2);
grid on
xlabel("f (Hz)", 'fontsize', 20);
ylabel("|H(w)| (in dB)", 'fontsize', 20);
hold on
yline(-3, '--', 'linewidth', 3, 'color', 'r')
legend("Magnitude Plot", "-3 dB line");
```

41/60

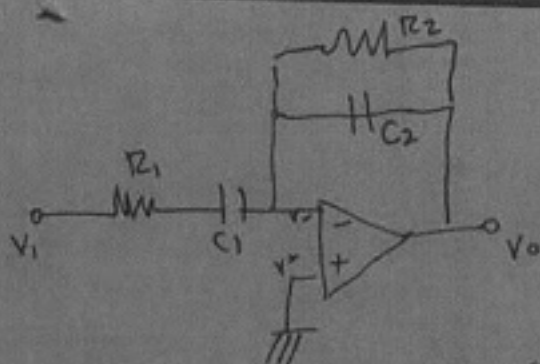
2) 10/10
MATLAB

2a) 20/20

2b) 8/10

2c) 0/10

2d) 3/10



* Using principle of virtual ground for op-amp.
 $V^- = V^+ = 0$

Apply KCL @ V^- node in Laplace domain.

$$\frac{V^- - V_i}{R + \frac{1}{sC_1}} + \frac{V^- - V_o}{R_2} + \frac{V^- - V_o}{1/sC_2} = 0$$

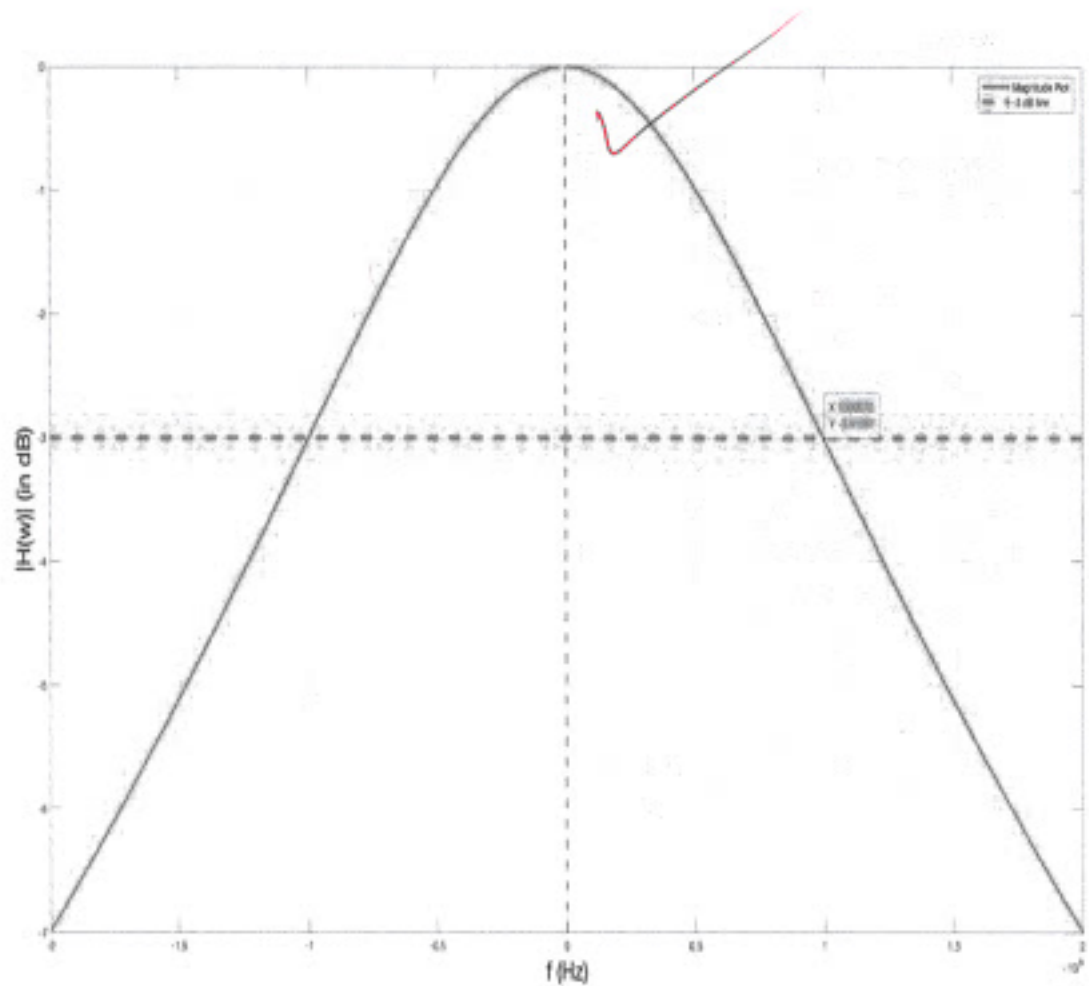
$$\frac{-V_i \cdot sC_1}{1 + sR_1C_1} = V_o \left(\frac{1}{R_2} + sC_2 \right)$$

$$\frac{V_o}{V_i} = \frac{sC_1R_2}{(1 + sR_1C_1)(1 + sC_2R_2)}$$

Given $R_1 = R_2 = 1k\Omega$ and $C_1 = 100\mu F$; $C_2 = 0.001\mu F$

$$\frac{V_o}{V_i} = \frac{s}{10 \left(1 + \frac{s}{10} \right) \left(1 + \frac{s}{1000000} \right)}$$

Magnitude Plot using MATLAB:



As can be seen, the centre frequency is 0 Hz and the bandwidth is 10 kHz.

The center frequency
and bandwidth are wrong

**NETWORK THEORY II
DESIGN PROJECT
FALL 2021**

PROJECT TITLE: DESIGN OF A BANDPASS FILTER

TOPICS COVERED IN PROJECT

- 1. Frequency Response**
- 2. Design of Bandpass Filter**
- 3. Breadboard of Design Circuit**
- 4. Analog Discovery Board**
- 5. Network Analyzer**

**NETWORK THEORY II
DESIGN PROJECT
FALL 2021**

**DETAILED DESIGN PROJECT PROBLEM STATEMENT
AND REQUIREMENTS**

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II / FALL 2021
DESIGN PROJECT

In this project, **a team consisting of about four students**, must design and construct band-pass filter that will meet some design specifications. A project report is required.

Design Specifications are as follows:

(a) Design a bandpass filter with the following specifications.

- Group 1: Center frequency of 4 KHz and quality factor of 0.3
- Group 2: Center frequency of 8 KHz and quality factor of 0.3
- Group 3: Center frequency of 12 KHz and quality factor of 0.3
- Group 4: Center frequency of 16 KHz and quality factor of 0.3
- Group 5: Center frequency of 20 KHz and quality factor of 0.3
- Group 6: Center frequency of 24 KHz and quality factor of 0.3
- Group 7: Center frequency of 28 KHz and quality factor of 0.3

(b) The maximum tolerance of the center frequency and quality factor should be **less than 10%**

(c) The power supply, if used, should have a voltage **equal or less than 5 volts**.

(d) The total cost of the components of your design should **be less than \$5.00**. The components cost can be found at Mouser Electronics (www.mouser.com). In calculating your cost, assume the price of one component in a lot of 100.

(e) To reduce the environmental impact of the design, the total number of elements used in the design should be **less than 7 electronic components**.

(f) Other considerations not relevant to this design project are public health and welfare, as well as global, cultural and social factors.

Project Requirements

1. Design the circuit, specify the components, test the circuit in the laboratory and ascertain that the specifications have been met.
2. You can use the electrical elements and electronic devices you can find in the laboratory.
3. Use the **Analog Discovery Board** to plot the magnitude response of your filter and include the plot in your report.
4. Call the instructor to verify that your circuit meets the design specifications after it has been built in the lab.

Report Writeup: The report should have the following Sections

(i) Title of project with Group Members' Names,

(ii) Introduction and Design Objectives (include basic of filters and design requirements)

(iii) Circuit Design (include circuit diagram, design equations, component values)

(iv) Design of Experiment (identify parameter to be measured; list the instrument being used for measurements; and draw the experimental setup)

(v) Conduct Experiment (describe steps for obtaining magnitude response with ADB Network Analyzer, considering safety precautions in the lab; provide the magnitude response figure obtained from ADB; provide the critical frequencies (center and cut-off frequencies) and quality factor of designed circuit.

(vi) Analysis and Interpretation of Experimental Results (present in tabular form critical frequencies, bandwidth from your experimental results, and critical frequencies from the design specifications; determine the percentage deviation of your measurement data from the design specifications)

(vii) Discussion of Results and Conclusions (draw appropriate conclusions and recommendation using engineering judgement)

Notes on writing the formal report: The report should be carefully written, with proper grammar and spelling. You are advised to make use of well-designed tables and graphs to present your design and measurement information. Each figure and table should have a numbered caption, and they should be referenced in the text.

Indicate in your report the amount of work done by each member in your group. Signatures of the members in your group indicating they participated actively in the project are required.

Submission (Two Submissions)

(i) Each team member must submit a copy of your team project report to Ecourses (under Design Project) by Thursday, November 18, 2021 by 11:59 p.m.

(ii) Each member of a team must submit a softcopy of the team project report to Taskstream: ELEG 3301-P01 by Thursday, November 18, 2021 by 11:59 p.m.

NETWORK THEORY II
FALL 2021

DETAILED PROJECT GRADING SCHEME

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
RUBRICS FOR GRADING DESIGN PROJECT
FALL 2021

GROUP NUMBER: _____

GROUP MEMBERS: 1. _____
 2. _____
 3. _____
 4. _____

RUBRICS FOR GRADING DESIGN PROJECT

ITEMS	POINTS ACHIEVED	MAXIMUM POINTS
1. Circuit was built and met design specifications - Technical specifications were met. - Design was checked by the instructor		30
2. Introduction and Design Objectives		5
3. Circuit Design - Circuit diagram, design calculations, component values, total cost of components - Simulations, if applicable		10
4. Design of Experiment to Test Designed Circuit (Student Outcome 6.1) - Identify parameters to be measured, list of equipment for measurements - Provide a figure of the experimental set-up		10
5. Conduct Experiment (Student Outcome 6.2) - Describe procedure for obtaining the required response from the Network Analyzer of the Analog Discovery Board; consider safety precautions in the lab, if any. - Provide the magnitude response plot - Obtain the critical frequencies and quality factor from magnitude response of the filter.		15
6. Analysis and Interpretation of Experimental Results (Student Outcome 6.3) - Present in tabular form the center frequency and quality factor of your experimental results - Provide in tabular form the center frequency and quality factor from the design specifications. - Use the appropriate statistical method to determine the percent deviation of your experimental data from those of design specifications.		15
7. Discussion of Results and Conclusions (Student Outcome 6.3) Draw appropriate conclusions and recommendations using engineering judgement.		10
8. General Write-up of Report - Grammar and Adequacy of plots and figures - Proper labeling of graphs and tables - Proper references to graphs and tables - Clear and meaningful sentences		5
9. Composite Report Grade		100
10. Grade for ABET Student Outcome 6 (Items #4, 5, 6, and 7)		50
11. Grade for ABET Student Outcome 6 (Normalized to 100%)		100

**ABOVE AVERAGE
PROJECT REPORT**

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
RUBRICS FOR GRADING DESIGN PROJECT
FALL 2021

GROUP NUMBER:

3

GROUP MEMBERS:

1. Kole Long ✓
2. Keithan Ross ✓
3. Terrell Gray ✓
4. Raysean Watson ✓

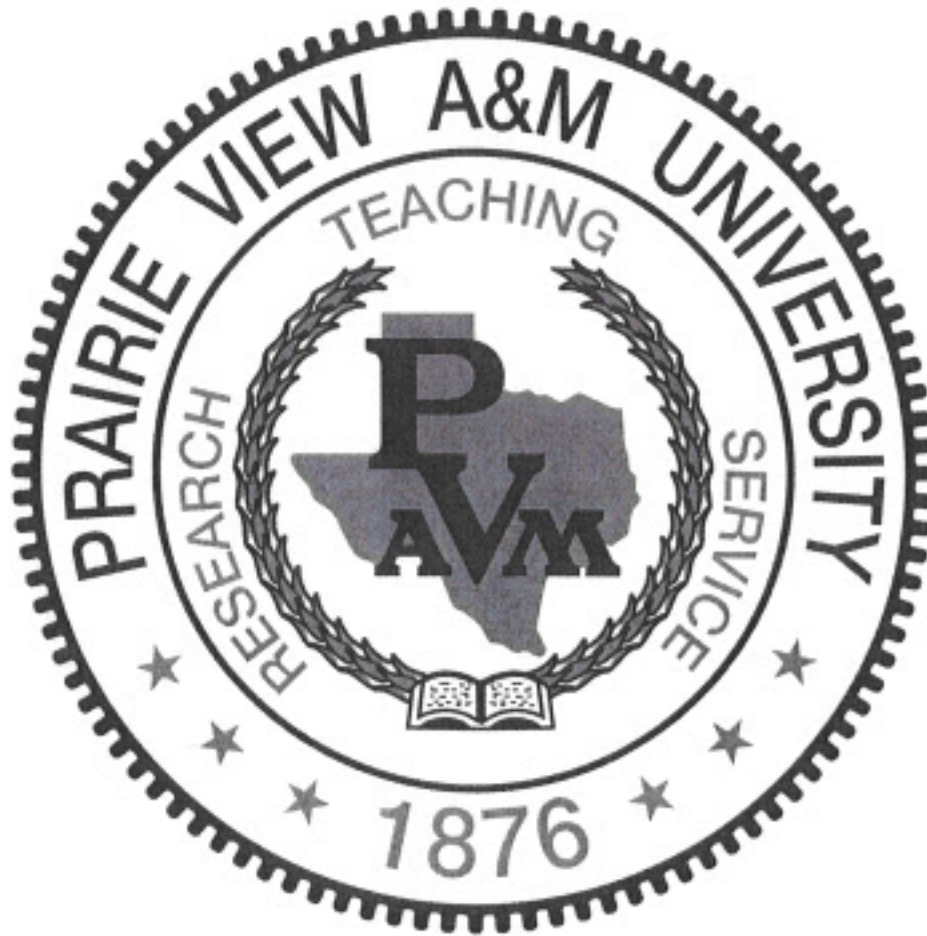
RUBRICS FOR GRADING DESIGN PROJECT

ITEMS	POINTS ACHIEVED	MAXIMUM POINTS
1. <i>Circuit was built and met design specifications</i> - Technical specifications were met. - Design was checked by the instructor	30	30
2. <i>Introduction and Design Objectives</i>	4	5
3. <i>Circuit Design</i> - Circuit diagram, design calculations, component values, total cost of components - Simulations, if applicable	10	10
4. <i>Design of Experiment to Test Designed Circuit (Student Outcome 6.1)</i> - Identify parameters to be measured, list of equipment for measurements - Provide a figure of the experimental set-up	9	10
5. <i>Conduct Experiment (Student Outcome 6.2)</i> - Describe procedure for obtaining the required response from the Network Analyzer of the Analog Discovery Board; consider safety precautions in the lab, if any. - Provide the magnitude response plot - Obtain the critical frequencies and quality factor from magnitude response of the filter.	14	15
6. <i>Analysis and Interpretation of Experimental Results (Student Outcome 6.3)</i> - Present in tabular form the center frequency and quality factor of your experimental results - Provide in tabular form the center frequency and quality factor from the design specifications. - Use the appropriate statistical method to determine the percent deviation of your experimental data from those of design specifications.	15	15
7. <i>Discussion of Results and Conclusions (Student Outcome 6.3)</i> Draw appropriate conclusions and recommendations using engineering judgement.	9	10
8. <i>General Write-up of Report</i> - Grammar and Adequacy of plots and figures - Proper labeling of graphs and tables - Proper references to graphs and tables - Clear and meaningful sentences	4	5
9. <i>Composite Report Grade</i>	95	100
10. <i>Grade for ABET Student Outcome 6 (Items #4, 5, 6, and 7)</i>	47	50
11. <i>Grade for ABET Student Outcome 6 (Normalized to 100%)</i>	94	100

Department of Electrical and Computer Engineering

Network Theory II Group Design Project

Group 3



Group Members: Kole Long, Keithan Ross, Terrell Gray, & Raysean Watson

Fall 2021

ELEG 3301-P01

Dr. Attia

Introduction and Design Objectives:

For the design project, our group was given the task of designing a bandpass filter with a center frequency, f_0 , of 12Khz and a quality factor, Q , of 0.3. While completing this design project, we were first required to draw the schematics of the circuit and use it to find the values of the resistance, capacitance, and inductance. Using these calculated values, we constructed our circuit on the breadboard. After this, we were able to use Waveform, which gave us the graph required to find the upper and lower cutoff frequencies, center frequency, and the quality factor. For our project, we were given a tolerance of ten percent, which means that both our center frequency and quality factor should be within the given parameters of 12 kHz and 0.3, respectively. Other requirements for this project included a power supply with a maximum of five volts, less than five dollar equipment costs, and finally to take into account the environmental impact by using no more than seven different electronic components. *New Paragraph*

Because we were tasked with creating a bandpass filter, it is important to know and understand the different types of filters in order to differentiate them from one another. There are 5 different types of filters: band-pass, low-pass, high-pass, band-stop (notch), and all-pass. Filters are considered circuits with the ability to amplify certain frequencies while simultaneously attenuating other frequencies. A low pass filter ~~debits~~ *attenuates* higher frequencies than the set cutoff frequencies and lets the lower frequencies pass. A high-pass frequency ultimately does the opposite, as it constricts frequencies that are lower than the set cut-off and lets frequencies that are higher pass. Band-stop filters, also called notch filters, ~~constrict~~ *attenuates* the frequencies that are in a certain range, but allow the other frequencies around it to pass. All-pass filters allow all frequencies to pass equally, but change the phase relationship amongst other frequencies. Finally, a band-pass filter, which is the one used in this project, combines the likes of the two other filters, as bandpass ✓

filters allow a certain range of signals with certain frequencies to pass, in its so-called passband, and attenuate all the other frequencies in its stopband (Karl, 2020). By completing this lab, we will demonstrate how a band-pass filter is supposed to look, as well as showing its function.

Circuit Design and Design of Experiment:

For the project, we were asked to design a RLC circuit that can actively reflect the measurements of an experimental circuit, and measured to be similar while adhering to the restrictions presented in the introduction. In order to find the measured values for the circuit, we had to finish the experimental results and calculate the values of the RLC circuit for the resistance, Capacitance, and Inductance, as shown in Figure 1

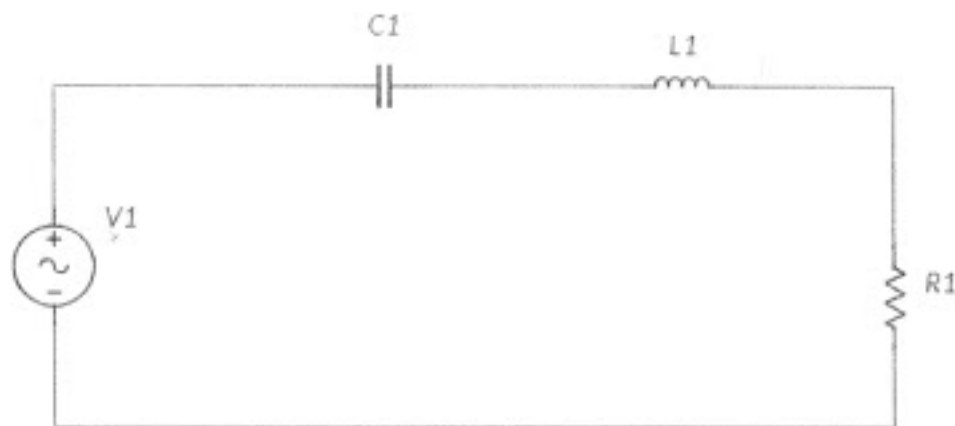


Figure 1: This figure provides a diagram of a typical RLC circuit. Each aspect of the circuit that must be calculated is labeled appropriately, including the voltage, inductance, capacitance, and resistance.

Along with the given design, we are to utilize the given values to calculate the missing variables; a Center frequency(f_0) of 12 kHz, and a Quality factor(Q) of 0.3, along with our Inductance value (L), chosen by the group, of 4.7 μH . For our results to be accurate, we must calculate the values of the final two variables: Resistance(R), and Capacitance(C).

The first calculation was to find the capacitance. In order to calculate the capacitance, we need to find the Angular frequency, given by the equation $\omega_0 = 2\pi \times f_0$. After plugging in the value of the center frequency, we can use the angular frequency to calculate the capacitance with the equation $\omega_0 = 1 / \sqrt{LC}$. Plugging in the given values and solving the equations, we achieve the following results:

- **Angular Frequency,**

$$\omega_0 = 2\pi \times (12 \times 10^3)$$

$$\omega_0 = 24000\pi$$

- **Capacitance,**

$$(24000\pi) = 1 / \sqrt{C \times (4.7 \times 10^{-3})}$$

$$\sqrt{C \times (4.7 \times 10^{-3})} = 1 / (24000\pi)$$

$$C \times (4.7 \times 10^{-3}) = (1 / (24000\pi))^2$$

$$C = ((1 / (24000\pi))^2) / (4.7 \times 10^{-3})$$

$$C \approx 3.74 \times 10^{-8} \text{ F}$$

After finding the capacitance value, we have all of the information needed to solve for the resistance, R. We use the equation $Q = (\omega_0 \times L) / R$. The result we found was:

- **Resistance,**

$$0.3 = ((24000\pi) \times (4.7 \times 10^{-3})) / R$$

$$R = ((24000\pi) \times (4.7 \times 10^{-3})) / 0.3$$

$$R = 1181.24 \Omega$$

Now that we have all the variables needed, we can build the circuit with the estimated values that will be similar to the calculated values in **Figure 2**.

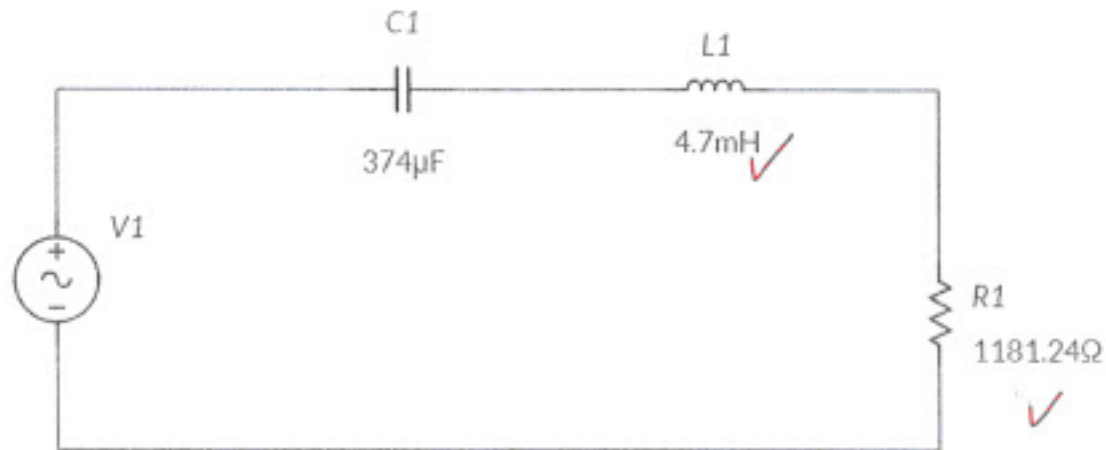


Figure 2: *This figure shows the updated schematic for our group's RLC circuit with the resistor, inductor, and capacitor labeled with their respective values, calculated above.*

The last thing to be accounted for before we can build the circuit is to find the price estimates for each part of the circuit. Using Mouser.com, we found the bulk prices of each piece and divided it by one hundred, as we only require one of each part. Prices for one piece of each component are as follows:

- **Cost of Parts,**

1.2k Ω Resistor: \$ 0.49

4.7 mH Inductor: \$ 1.61

0.0374 μ F Capacitor: \$ 0.218 ✓

Total cost: \$ 2.32

Because our total cost, \$2.32, is less than \$5.00, we can conclude that we have adhered to the restrictions of the project by staying within our given budget. ✓

Due to equipment limitations in the laboratory, we were forced to adapt and slightly alter the values of our RLC circuit. The estimated values that we used for the Analog Discovery board are as follows, and will be shown in **Figure 3.** ✓

- **Estimated Values of Circuit,**

Resistor- 1000 Ohms

Inductor- 4.7 mH (value did not change)

Capacitor- 47 nF

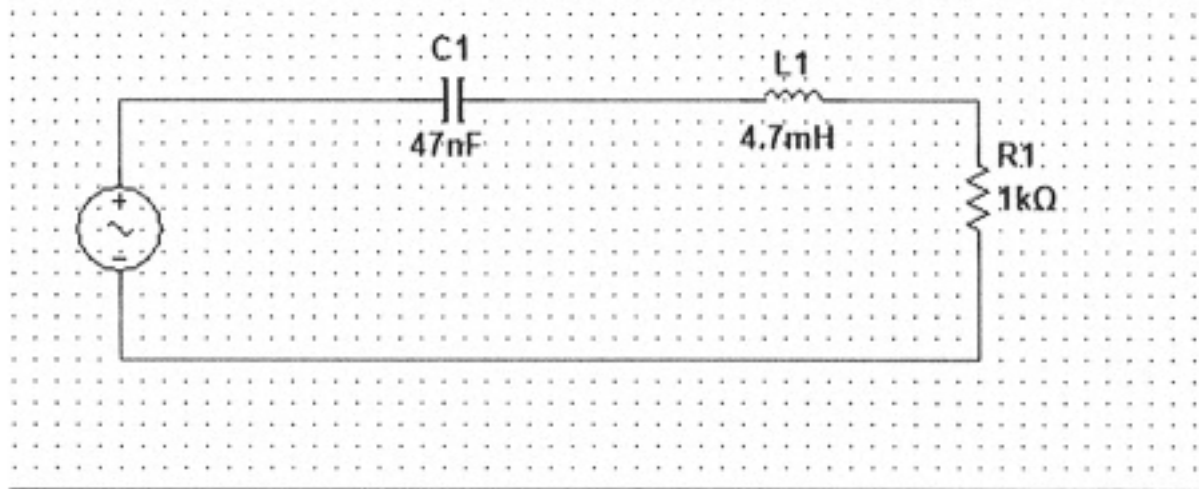


Figure 3: *This figure shows the RLC Circuit schematic with the estimated values of our calculations. These values were used due to a lack of resources in the laboratory.*

Though our group made the decision to slightly alter the values in the circuit, our values continued to meet the ten percent tolerance requested, as well as the other requirements expected in the project, and this will be mathematically proved in the next section. ✓

Conduct Experiment:

After making the mock up before building the circuit, we can now measure the Maximum Center Frequency and Quality Factor for the soon to be built circuit, which should match the values given in order to prove that the resistor, capacitor, and inductor variables were calculated accurately. The instrument that we used to calculate these values was the Analog Discovery Board.

1. Construct the circuit on breadboard & connect analog discovery
2. Generate the sine wave in Wavegen module with a 3V and frequency of 1kHz

3. Select "Run" and measure peak-to-peak voltage at node Channel 2+ of the module
4. Change frequency of the Wavegen to calculated value
5. Measure peak-to-peak voltage at node channel 2+
6. Start at 20 kHz up to 100 kHz in increments of 10 kHz

1. Select Set up values for Network Analyzer

- Start Frequency : 50 kHz
 - Stop Frequency : 500 kHz
 - Offset : 0V
 - Input Signal Amplitude : 1V
 - Max Filter Gain : 1X
 - Bode scale : Magnitude Top 0dB, Range -10 dB
 - Phase - Top 90 deg, Range 180 deg.
 - Scope Channel Gain: Channel 1: 1X Channel 2: 1X
1. Connect the Scop Module indicate in Figure 2: Experimental set up
 2. Select the "Single" to obtain a single sweep of the frequency, obtaining the magnitude plot of the frequency response in the circuit
 3. Record the Frequency where the peak occurs on the Magnitude (dB) vs Frequency (kHz)
 4. Using the Quick Measure tool move to the peak of the plot where resonant frequency resides & select the -3dB and left click to mark low & high cut off frequencies

Quality

$$W_o * L / R = \frac{24000\pi \cdot (4.7 \cdot 10^{-3})}{1200} = .295 \checkmark$$

Center Frequency

$$1/2\pi \sqrt{\square\square} = \frac{1}{2\pi \sqrt{(4.7 \cdot 10^{-3}) \cdot (47)}} = 12.03 \text{ KHz} \checkmark$$

Low Cut Off Frequency

$$1/2\pi\square\square = \frac{1}{2\pi \cdot 1000 \cdot 4.7 \cdot 10^{-3}} = 3.386 \text{ kHz} \checkmark$$

High Cut Off frequency

$$\square = \square\square(\sqrt{1 + 1 + 4\square^2} + 1/2\square) = 43.323 \square\square \checkmark$$

Bandwidth

$$\square\square\square\square\square / \square\square\square\square\square\square = 12.03 \square\square\square + .295 = 40.78\text{kHz}$$

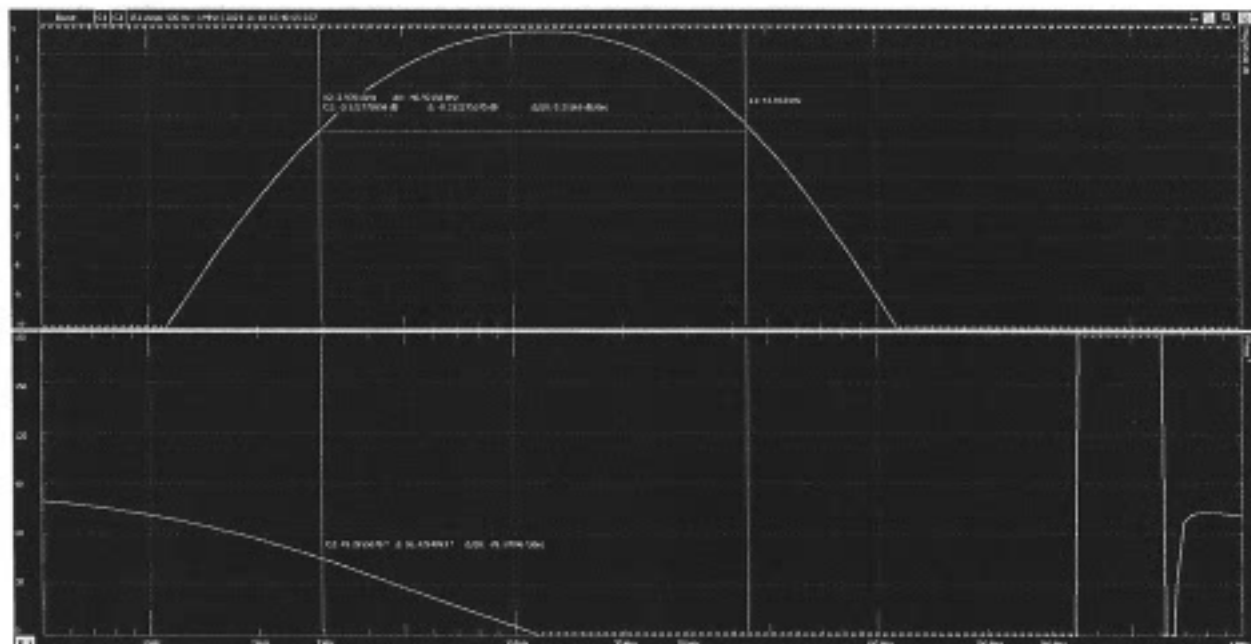


Figure 4: Shown above are the cut-off frequencies, upper and lower as well as the quality factor.

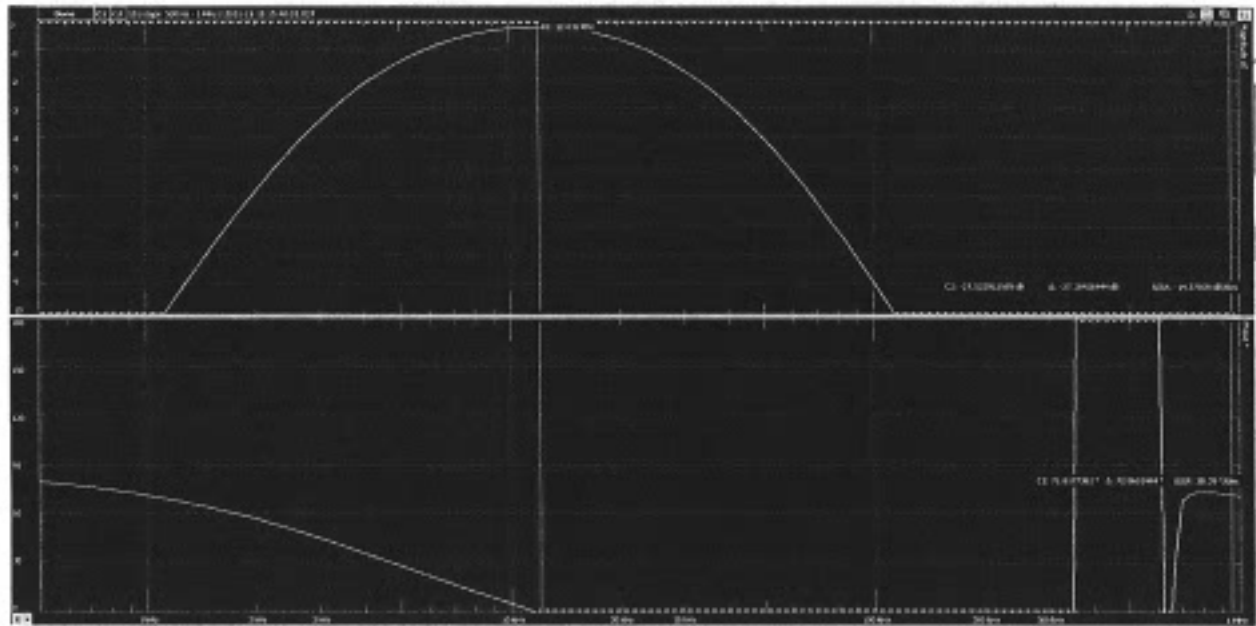


Figure 5: This figure shows a picture of the graph obtained, as well as the center frequency of said graph.

Analysis and Interpretation of Experimental Results:

Table 1: Design Specifications and Experimental Results

	Center Frequency	Quality Factor	Bandwidth	Cut-off Frequency Left	Cut-off Frequency Right
Design Specifications	12 KHz	0.3	40 KHz	3.386 KHz	43.323 KHz
Experimental Results	12.032 KHz	0.298	40.376 KHz	3.1 KHz	43.892 KHz

Table 1: This table shows a comparison of the values that were given at the start of the project and the values that were experimentally calculated in the project. The small difference in value between the numbers tells us that our calculations were extremely accurate.

As stated multiple times in the report, the allowed tolerance of the center frequency and quality factor was ten percent. The tolerance percentage basically serves as the margin of error, so that means that for our experimental results to be feasible, the values obtained from the experiment would have to be within ten percent of the given values of both the center frequency and quality factor. To find the upper and lower values of the margin of error for both values, we

must multiply the given values by 0.1, then subtract and add the original values by the result.

This process is shown here:

- **Center Frequency Margin of Error,**

$$\% \text{ error} = \frac{|\text{Accepted} - \text{Measured}|}{\text{Accepted}} \times 100 \quad \checkmark$$

$$\text{Center Frequency Percent Error} = ((12.032 \text{ kHz} - 12 \text{ kHz}) / 12.032 \text{ kHz}) \times 100\%$$

$$\text{Center Frequency Percent Error} = \underline{\underline{0.26\%}} \quad \checkmark$$

$$\text{Margin of Error} = (\text{given value} \times 0.1)$$

$$\text{Margin of Error} = 12 \text{ kHz} \times 0.1 = 1.2 \text{ kHz}$$

$$\text{Upper Margin} = 12 \text{ kHz} + 1.2 \text{ kHz} = 13.2 \text{ kHz}$$

$$\text{Lower Margin} = 12 \text{ kHz} - 1.2 \text{ kHz} = 10.8 \text{ kHz} \quad \checkmark$$

In order to meet the tolerance requirements, the center frequency found in the experiment must be between 10.8 kHz and 13.2 kHz.

- **Quality Factor Margin of Error,**

$$\text{Quality Factor Percent Error} = ((0.298 - 0.3) / 0.298) \times 100\%$$

$$\text{Quality Factor Percent Error} = \underline{\underline{0.671\%}} \quad \checkmark$$

$$\text{Margin of Error} = (\text{given value} \times 0.1)$$

$$\text{Margin of Error} = 0.3 \times 0.1 = 0.03$$

$$\text{Upper Margin} = 0.3 + 0.03 = 0.33$$

$$\text{Lower Margin} = 0.3 - 0.03 = 0.27$$

- **Bandwidth Margin of Error,**

$$\text{Percent Error} = ((40.376 - 40) / 40.376) \times 100\%$$

$$\text{Percent Error} = \underline{\underline{0.931\%}} \quad \checkmark$$

- **Upper Cut-off Frequency Margin of Error,**

$$\text{Percent Error} = ((43.892 - 43.323) / 43.892) \times 100\%$$

$$\text{Percent Error} = \underline{1.296\%}$$

- **Lower Cut-Off Frequency Margin of Error,**

$$\text{Percent Error} = ((3.1 - 3.386) / 3.1) \times 100\%$$

$$\text{Percent Error} = \underline{9.226\%}$$

In order to meet the tolerance requirements, the quality factor found through the experiment must be between 0.27 and 0.33.

As shown in Figure 6, our experimental results for both the center frequency and quality factor fell within the range specified by the tolerance, with the center frequency being 12.032 kHz and the quality factor being 0.298. Because of this, we can assume that our design met all of the required specifications, and is therefore acceptable.

Discussion of Results and Conclusions:

The values that were calculated before the creation of the RLC circuit and band-pass filter were reflected correctly through mathematics as well as the Analog Discovery board, and we were able to prove that our values stayed within the ten percent tolerance window that we were presented at the start of the project. Because of this, we can accurately conclude that our project design does meet the required specifications of the project, making this a successful and feasible design.

After conducting this experiment and succeeding in creating the desired circuit whilst adhering to the required specifications, we can conclude that we understood the purpose of this design project. By undertaking this project, we are more knowledgeable about not only band-pass filters, but all filters. We also have become more adept at finding the center frequency, the two cutoff frequencies, and the quality factor. After constructing the actual band-pass filter on

the breadboard and waveform generator, we are now able to differentiate band-pass filters from other types of filters and see how it ~~constricts~~ ^{attenuates} certain frequencies around it. This design project allowed us to finally implement everything that we learned in the course and work as a team to determine how to most efficiently complete the task assigned to us, which is important because projects similar to these are exactly what we will have to undertake in the workplace, thus making this knowledge and experience vital to our success in the near future.

✓
Very Good Report

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**AVERAGE
PROJECT REPORT**

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
RUBRICS FOR GRADING DESIGN PROJECT
FALL 2021

GROUP NUMBER:

6

GROUP MEMBERS:

1. Ibinabo Omie-Abbey
2. Tyreese Washington ✓
3. Chris West ✓
4. Trevion Jordan ✓

RUBRICS FOR GRADING DESIGN PROJECT

ITEMS	POINTS ACHIEVED	MAXIMUM POINTS
1. <i>Circuit was built and met design specifications</i> - Technical specifications were met. - Design was checked by the instructor	30	30
2. <i>Introduction and Design Objectives</i>	4	5
3. <i>Circuit Design</i> - Circuit diagram, design calculations, component values, total cost of components - Simulations, if applicable	10	10
4. <i>Design of Experiment to Test Designed Circuit (Student Outcome 6.1)</i> - Identify parameters to be measured, list of equipment for measurements - Provide a figure of the experimental set-up	8	10
5. <i>Conduct Experiment (Student Outcome 6.2)</i> - Describe procedure for obtaining the required response from the Network Analyzer of the Analog Discovery Board; consider safety precautions in the lab, if any. - Provide the magnitude response plot - Obtain the critical frequencies and quality factor from magnitude response of the filter.	13	15
6. <i>Analysis and Interpretation of Experimental Results (Student Outcome 6.3)</i> - Present in tabular form the center frequency and quality factor of your experimental results - Provide in tabular form the center frequency and quality factor from the design specifications. - Use the appropriate statistical method to determine the percent deviation of your experimental data from those of design specifications.	13	15
7. <i>Discussion of Results and Conclusions (Student Outcome 6.3)</i> Draw appropriate conclusions and recommendations using engineering judgement.	9	10
8. <i>General Write-up of Report</i> - Grammar and Adequacy of plots and figures - Proper labeling of graphs and tables - Proper references to graphs and tables - Clear and meaningful sentences	4	5
9. <i>Composite Report Grade</i>	91	100
10. <i>Grade for ABET Student Outcome 6 (Items #4, 5, 6, and 7)</i>	43	50
11. <i>Grade for ABET Student Outcome 6 (Normalized to 100%)</i>	86	100

Network Theory II

ELEG3301-P01

Design Project - Group 6



Group Members:

Ibinabo Omic-Abbey

Tyreese Washington

Chris West

Trevion Jordan

(II) Introduction and Design Objectives:

The objective of this project is to design a bandpass filter circuit with certain specifications, as well as obtain and analyze data found using a breadboard and Waveform software. A bandpass filter is a device that passes and rejects frequencies depending on if they're within a specified range. Bandpass filters are commonly used in wireless transmitters and receivers. The main function of this filter in a transmitter is to limit the bandwidth of the o/p signal to the band allotted for the transmission. This avoids the transmitter from interfering with further stations.

Design Specifications are as follows:

1. Design a band pass filter with a center frequency of 24 KHz and quality factor of 0.3
2. The maximum tolerance of the center frequency and quality factor was less than 10%
3. The power supply, if used, should have a voltage equal or less than 5 volts.
4. The total cost of the components of our design was less than \$5.00.
5. The components cost can be found at Mouser Electronics (www.mouser.com). In calculating your cost, assume the price of one component in a lot of 100.
6. To reduce the environmental impact of the design, the total number of elements used in the design should be less than 7 electronic components.

(III) Circuit Design:

By identifying the calculations of figure 1.a where bandpass filter was created When the central frequency was 24×10^3 kHz, we found ω_0 to be 1.51×10^5 rad/s. We utilized the resonant frequency equation and set the inductance to 10 mH to calculate the capacitance, which was 4.39×10^{-9} F. Finally, using the quality factor equation, the resistance was determined to be $5.03 \times 10^3 \Omega$, which was approximated to $5k\Omega$. The bandpass filter (Fig. 1.B) was then drawn using these values, with the circuit component values given.

$$\begin{aligned}\omega_0 &= 2\pi(f_0) \\ \omega_0 &= 2\pi(24 \times 10^3) \\ \omega_0 &= 1.51 \times 10^5 \text{ rad/s} \\ \omega_0 &= \frac{1}{\sqrt{LC}} ; L = 10 \text{ mH} = 10 \times 10^{-3} \text{ H} \\ \omega_0^2 &= \frac{1}{LC} \Rightarrow C = \frac{1}{\omega_0^2 L} \\ C &= \frac{1}{(1.51 \times 10^5)^2 \times 10^{-2}} = \frac{1}{(1.51^2 \times 10^{10}) \times 10^{-2}} \\ \{C &= 4.39 \times 10^{-9} \text{ F}\} \\ Q &= \frac{\omega_0 L}{R} \Rightarrow R = \frac{\omega_0 L}{Q} \\ R &= \frac{(1.51 \times 10^5)(10 \times 10^{-3})}{0.3} \\ \{R &= 5.03 \times 10^3 \Omega \approx 5k\Omega\} \\ Q &= \frac{f_0}{f_2 - f_1} = \frac{24.677}{94.067 - 6.2117} \\ \{Q &= 0.28088231\}\end{aligned}$$

Figure 1.A: Calculations used to obtain data used in design

$\omega_0 = 1.51 \times 10^5$ rad/s, $L = 10 \times 10^{-3}$ H, $R = 5.03 \times 10^3 \Omega \approx 5k\Omega$, $Q = 0.28088231$

After calculating the equations above we have now found our values and are now able to find our components.

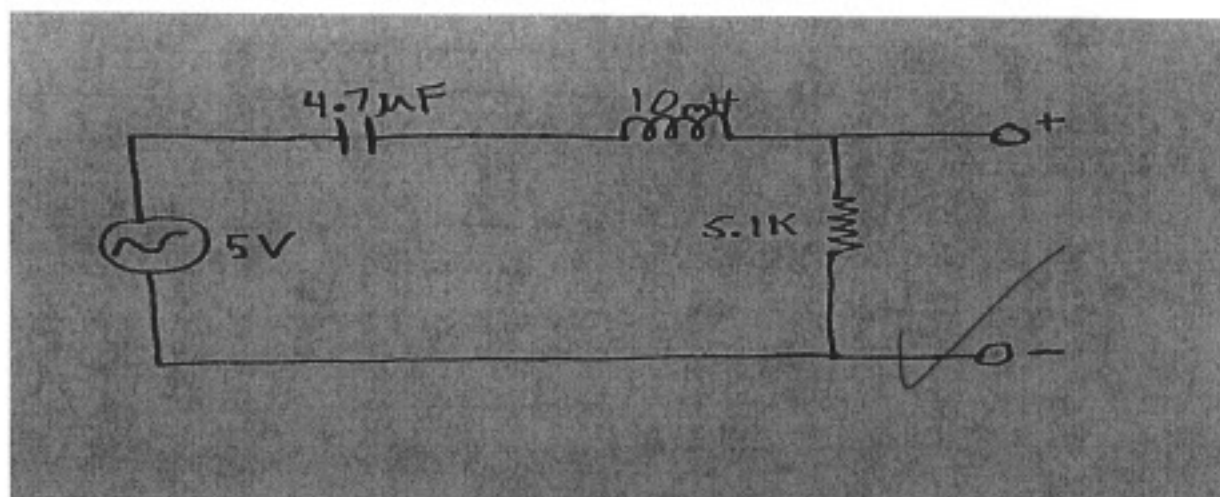


Figure 1.B: Band filter using Calculations

(IV) Design of Experiment:

Figure 2.A: Here above is the Analog Discovery Board circuit to find the magnitude response of the filter.

List of resource used in the Experiment include:

- Waveform Software
- Breadboard
- Analog Discovery Board utilized (Channel 1, 2, ground)
- 4.7 μF inductor
- 10mH capacitor
- 5k Ω resistor



(V) Conduction of Experiment:

We constructed a bandpass filter with the components values of $L=10\text{mH}$, $C=4.7\mu\text{F}$, $R=5.1\text{K}\Omega$. After constructing our circuit on the breadboard using the Analog discovery board we successfully got a center frequency of 24kHz and quality factor 0.3 on the waveform generator. Then we also used the waveform generator to get the magnitude response low cut off frequency of 6.2117kHz , and the high cutoff frequency of 94.067kHz . Therefore we achieved the required results for this said project experiment.

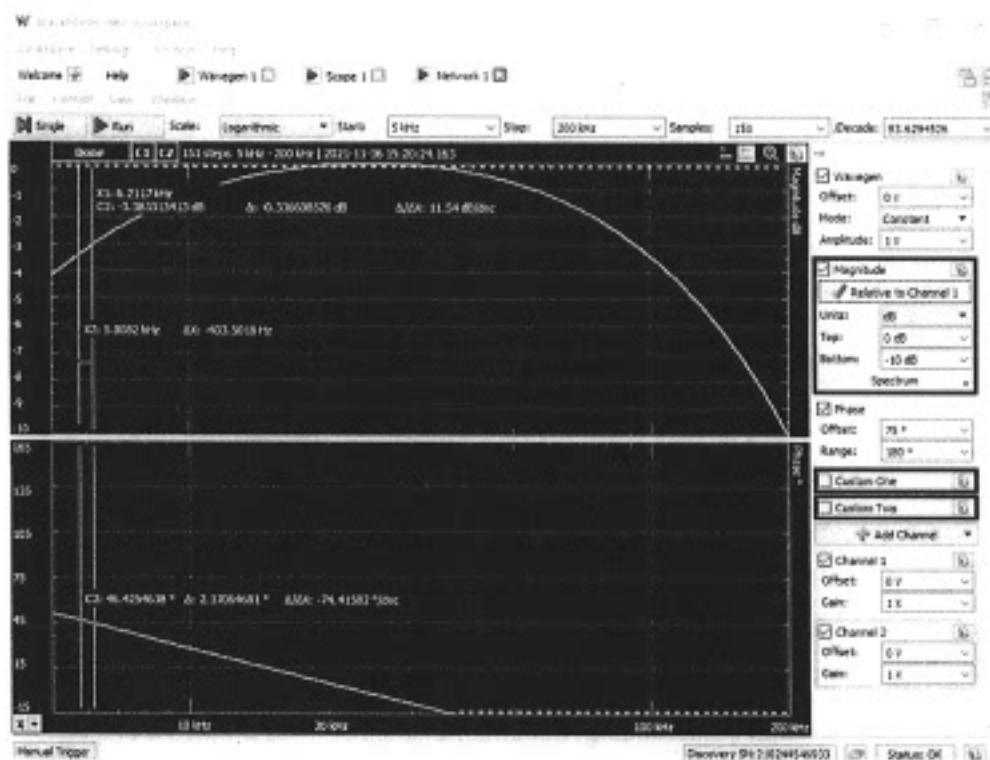


Figure 3.A: Magnitude Response Low cutoff Frequency = 6.2117 kHz

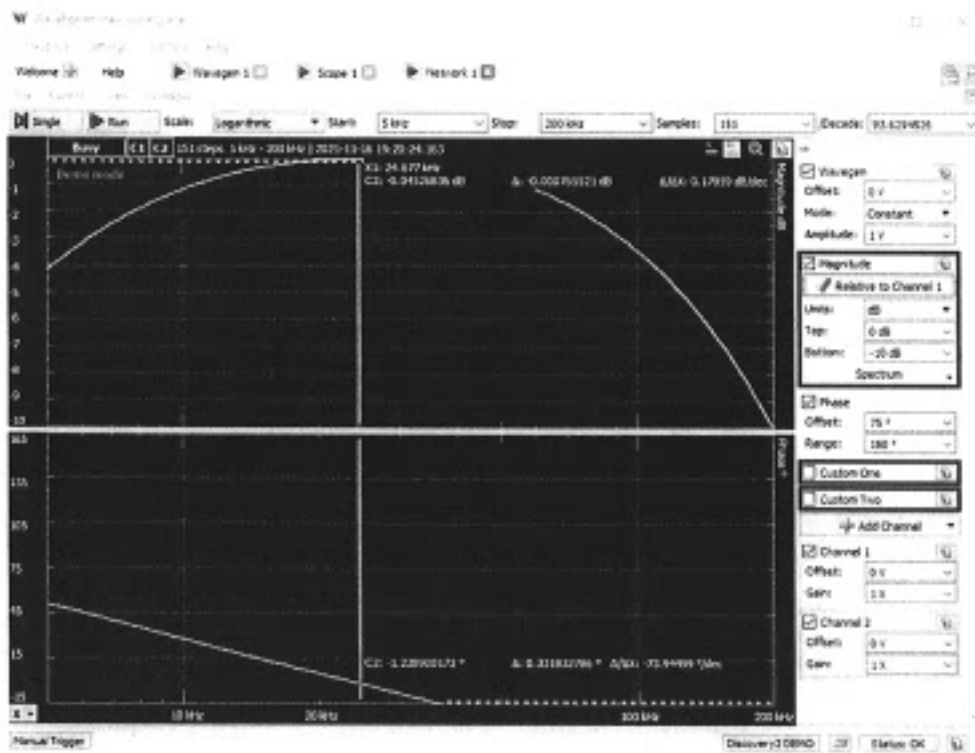


Figure 3.B: Center Frequency = 24.677kHz ✓

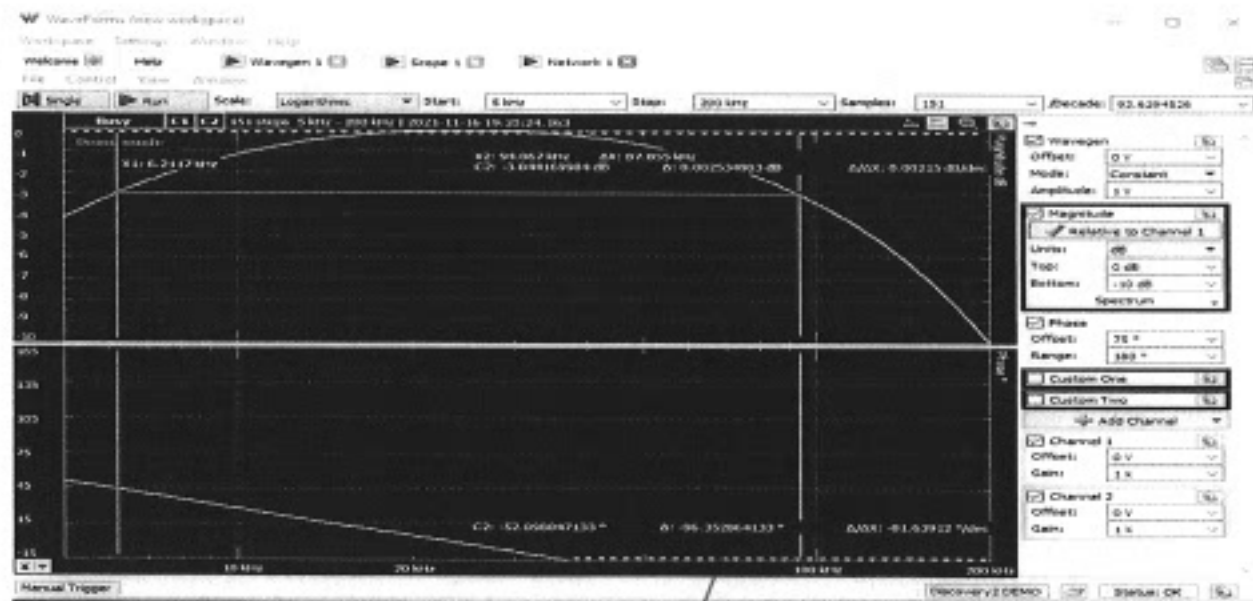


Figure 3.C: High Cutoff Frequency = 94.067 ✓

Center frequency = 24.677kHz ,
High cutoff frequency = 94.067 kHz,
Low cutoff frequency = 6.2117 kHz

(VI) Analysis and Interpretation of Experimental Results:

Results from the Experiment	
Center Frequency, (ω_0)	$1.51 * 10^5 \text{ rad/s}$
Capacitance, (C)	$4.39 * 10^{-9} \text{ F}$
Resistance, (R)	$5.03 * 10^3 \text{ k} \approx 5\text{k}$
Inductance, (L)	$10 * 10^{-3} \text{ mH}$
Quality Factor (Q)	0.28088231
High cutoff frequency	94.067 kHz
Low cutoff frequency	6.2117 kHz ✓

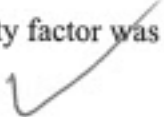
Table 1.A: Results

The experiment follows all of the specifications previously stated above in the design. Furthermore, the quality factor and maximum tolerance are less than ten percent. Only 5 volts was needed for the design of figure (1.B) and only three electrical components were required. Overall, with the parameters given all instructions were carefully followed.

What about the percentage deviation calculations?

Discussion of Results and Conclusions:

The purpose of this project was to design a bandpass filter circuit using a breadboard and Waveform software with certain specifications. The bandpass filter circuit was constructed using calculations that were made from the given center frequency and quality factor. After creating a bandpass filter, the circuit was implemented into the Waveform Software, where we were able to simulate the circuit design and acquire the magnitude response. Using Waveform Software, we were to calculate the Center Frequency, and the Low and High cutoff frequency. At the end of our experiment our quality factor had to be within a certain range. The results of the quality factor had to be no higher than 0.3 and with ours being 0.28, our quality factor was in range.



Labor Division

- **Trevion Jordan**
 - Lead Breadboard Designer
 - Lead Waveforms Interpreter
 - Conduction of Experiment Subsection
 - Design of Experiment Subsection
- **Chris West**
 - Introduction & Design Objective Subsection
 - Analysis & Interpretation Subsection
 - Breadboard Design Assistance
 - Waveforms Interpretation Assistance
- **Ibinabo Omie-Abbey**
 - Circuit Design Calculations
 - Circuit Design Subsection
 - Breadboard Design Assistance
 - Waveforms Interpretation Assistance
- **Tyreese Washington**
 - Title of Project Page & Project Formatting
 - Discussion of Results & Conclusion Subsection
 - Breadboard Design Assistance

- Waveforms Interpretation Assistance

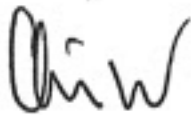
Signatures



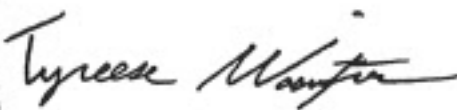
Trevion Jordan



Ibinabo Omie-Abbey



Chris West



Tyreese Washington

BELOW AVERAGE
PROJECT REPORT

PRAIRIE VIEW A&M UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ELEG 3301-P01 NETWORK THEORY II
RUBRICS FOR GRADING DESIGN PROJECT
FALL 2021

GROUP NUMBER:

5

GROUP MEMBERS:

1. Jarrod Ballou ✓
2. Wesley Ponder ✓
3. _____
4. _____

RUBRICS FOR GRADING DESIGN PROJECT

ITEMS	POINTS ACHIEVED	MAXIMUM POINTS
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7. <i>Discussion of Results and Conclusions (Student Outcome 6.3)</i> Draw appropriate conclusions and recommendations using engineering judgement.	7	10
8. <i>General Write-up of Report</i> - Grammar and Adequacy of plots and figures - Proper labeling of graphs and tables - Proper references to graphs and tables - Clear and meaningful sentences	4	5
9. <i>Composite Report Grade</i>	70	100
10. <i>Grade for ABET Student Outcome 6 (Items #4, 5, 6, and 7)</i>	29	50
11. <i>Grade for ABET Student Outcome 6 (Normalized to 100%)</i>	58	100

Network Theory 2 Group 5 Project



Jarrold Ballou

Wesley Ponder

Report: Wesley Ponder and Jarrod Ballou met with Dr. Attia in the lab, and together we selected a 10 mH Inductor in order to help us find the proper capacitor that will equal our group's assigned center frequency, 20k Hz, and would later use that capacitor value to find the necessary resistor value which would give us the given quality factor of, 0.3. In our original calculations we concluded that our ideal capacitance would be around 6.33nF, and our ideal resistance would be 4.189k ohms. In reality we used two capacitors each having 4.7nF, equaling 9.4nF, and we used a 4.2k resistor. When the circuit was set up and the Analog Discovery Board was connected, we plotted our center frequency and magnitude and acquired a center frequency of 18.34k Hz with cutoff frequencies of 3.94k Hz and 78.5k Hz, which gave us a quality factor of 0.246. The quality factor was too low and the center frequency needed to be adjusted as well, so we tried resolving the issue by reducing our resistance to match the quality factor. The change in resistance would also change the center frequency, and after recalculating the math we settled on a resistance of 3.16k ohms. This resulted in our center frequency becoming 20.8k Hz with cutoff frequencies of 5.19k Hz and 58.27k Hz, which gave us a quality factor of 0.39. These values were now too high for our given quality, as it cannot be higher than 10% of the given quality factor (0.3) and we found our math was off as the capacitance value was lower when calculating for resistance. In order to correct this, we simply increased the resistance from 3.16k ohms to 3.3k ohms, which resulted in us acquiring a center frequency of 18.1k Hz with cutoff frequencies of 5.0k Hz and 60.53k Hz, and a quality factor of 0.32. Dr. Attia seeing that our work was within the acceptable range approved us on the good work.

1. The format for writing this report ~~was~~ was not followed
2. What equations did you use to calculate your element values?
3. Sections on "Conduct Experiment" and "Analysis and Interpretation of Results" would have greatly helped in the write-up, instead of grouping them all other
4. What is your major conclusion of this work?
5. What is the total cost of components?
6. The procedure for conducting the experiment was not described in detail.

Calculations:

Group 5

Team Members: Jarrod Ballou
Wesley Ponder

Range of error cannot exceed 10% of the ideal in either direction of magnitude

Range Cap: 18 to 22 nF Range QF: 0.25 to 0.75

Center Frequency

20 kHz

Quality Factor

0.3

Group 5

Wrt $2\pi f L$

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$Q = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 CR}$$

$$\text{if } L = 10 \text{ mH} = 10 \times 10^{-3}$$

$$2\pi \times 20 \times 10^3 = \frac{1}{\sqrt{(10 \times 10^{-3})C}}$$

$$\left(\frac{2\pi \times 20 \times 10^3}{1}\right)^2 = \frac{1}{(10 \times 10^{-3})C}$$

$$\left(\frac{1}{2\pi \times 20 \times 10^3}\right)^2 = (10 \times 10^{-3})C$$

$$C = \left(\frac{1}{2\pi \times 20 \times 10^3}\right)^2 / (10 \times 10^{-3})$$

$$C = 6.33 \times 10^{-9} \approx 6.33 \text{ nF} \approx 9.4 \text{ nF}$$

$$Q = \frac{1}{\omega_0 CR} \rightarrow R = \frac{1}{\omega_0 CQ}$$

$$R = \frac{1}{(2\pi \times 20 \times 10^3)(6.33 \times 10^{-9})(0.3)}$$

$$R = 4181.1 \approx 4.18 \text{ k}\Omega \approx 4.2 \text{ k}\Omega$$

Real

Findings

Center Frequency: 18.7 kHz

$$\text{Lossing } Q \rightarrow \frac{1}{Q} = \frac{1}{0.3} = 3.33$$

For 18.7

$L = 10 \text{ nH}$

$C = 2.9 \text{ nF}$

Actual

Solution

Reduce

Resistor

$$R_2 = \frac{1}{(2\pi \times 18.7 \times 10^3)(9.4 \times 10^{-9})(0.3)}$$

$$R_2 = 3156 \approx 3.16 \text{ k}\Omega$$

Real

New Findings

Center Frequency: 20.8 kHz

58.29°

5.19°

Actual

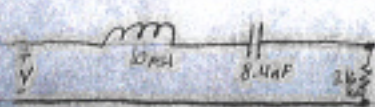
Solution

Reduce

Resistor

Quality Factor: 0.39

Circuit Design



Solution

Improve

Result

2.16 to 1.2

CP: 18.7

F: 60.52

C: 5.19

Q: 0.32

✓

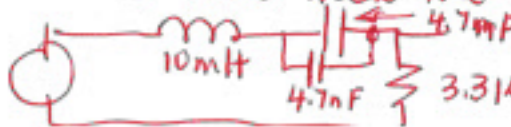
Factoring in quality factor

3.3 kΩ real resistor

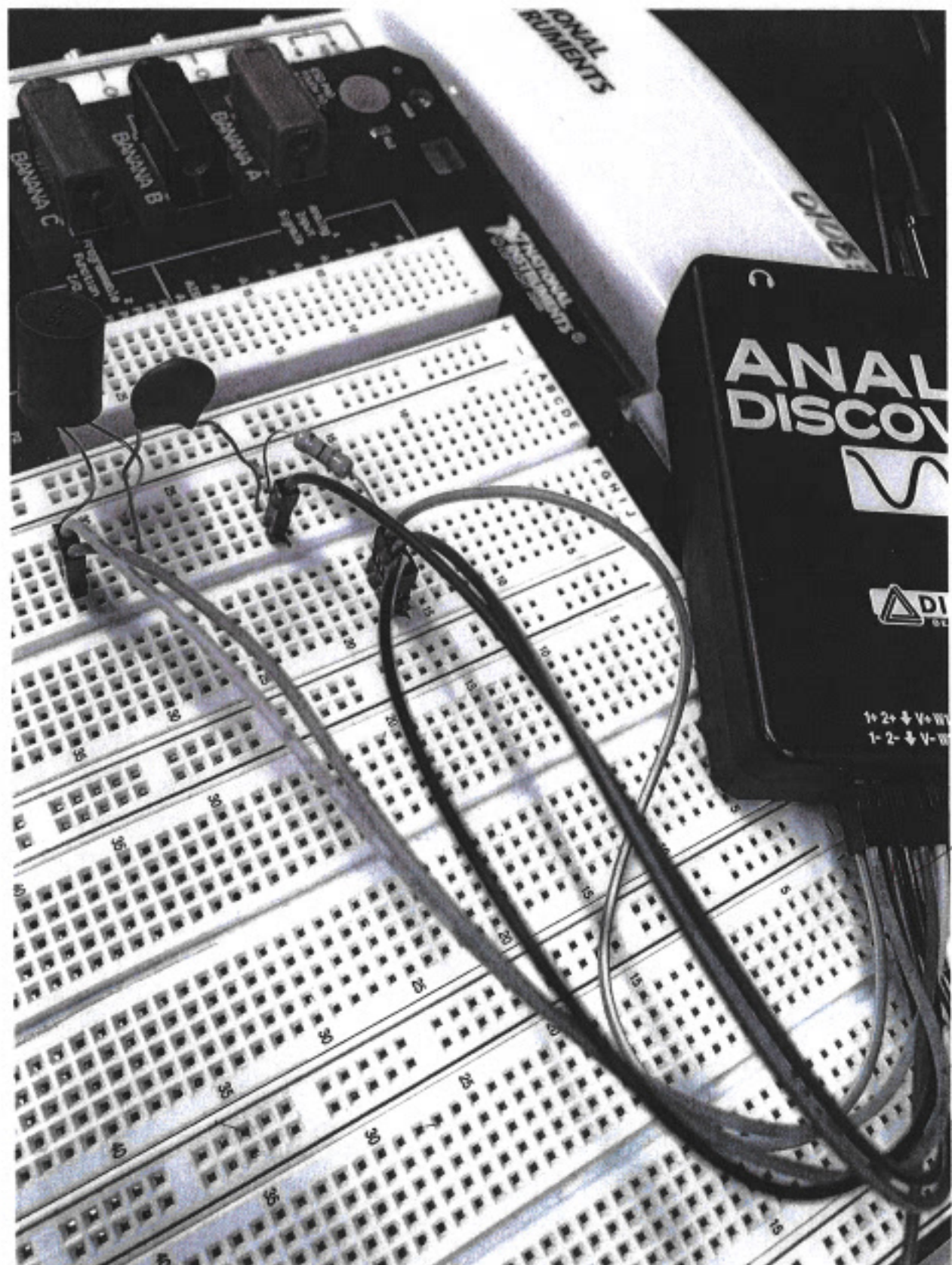
Used Analog Discovery Board to plot

Center Frequency

The circuit that met the specs was:



Circuit:



WaveForms Results:

