

DEPARTMENT OF BASIC SCIENCES AND ISLAMIAT  
University of Engineering and Technology, Peshawar

Paper: Complex Variables (BSI-362)  
Final-Term Examination Fall-2021  
(Computer System Engineering)

Max Marks: 60

Time Allowed: 03 hours

Note: Attempt all questions:

✓ Question No 1 (CLO-1, PLO-1, 6+6)

(a) Find "a" and "b" so that the given function is harmonic and find a harmonic conjugate

$$u = ax^3 + bxy$$

(b) Find the principal value of  $(1+i)^{1-i}$

Question No 2 (CLO-1, PLO-1, 6+6)

(a) Evaluate the integral  $\oint_C \coth \frac{1}{2} z \, dz$  C the circle  $|z - \frac{\pi i}{2}| = 1$

(b) Evaluate the integral  $\oint_C \frac{4z^3 - 6}{z(z-1-i)^2} \, dz$

C consists of  $|z| = 3$  counter-clockwise and  $|z| = 1$  clockwise

Question No 3 (CLO-2, PLO-2, 6+6)

(a) Find the Maclaurin series of  $f(z) = \int_0^z \sin t^2 \, dt$

(b) Evaluate the integral by residue method  $\oint_C \frac{z \cosh \pi z}{z^4 + 13z^2 + 36} \, dz$

$$|z| = \pi$$

Question No 4 (CLO-2, PLO-2, 6+6)

(a) Evaluate the integral  $\int_0^{2\pi} \frac{1 + \sin \theta}{3 + \cos \theta} \, d\theta$

(b) Find the Cauchy principal value  $\int_{-\infty}^{\infty} \frac{x^2}{x^4 - 1} \, dx$

Question No 5 (CLO-2, PLO-2, 6+6)

(a) Find the Fourier transform of  $f(x) = \begin{cases} e^x & \text{if } -1 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases}$

(b) Find the Complex Temperature field F between two coaxial cylinders of radii  $r_1$  and  $r_2$  having Temperature  $T_1$  and  $T_2$  respectively, where  $r_1 = 1$ ,  $r_2 = 3$ ,  $T_1 = 0$  and  $T_2 = 100$ .

Department of Basic Sciences & Islamiat  
University of Engineering and Technology Peshawar

Computer System Engineering

Final Term Examination 3<sup>rd</sup> Semester Fall – 2021

Paper: 75 Linear Algebra (BSI-111)

Maximum Marks: 100

Time: 03 Hours

Note: Attempt all questions. A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit.

[CLO1]

17  
30

Q1. a. Discuss the consistency of the following system of linear equations

$$5x_1 - 2x_2 + x_3 = 3$$

$$3x_1 + 2x_2 + 7x_3 = 5$$

$$x_1 + x_2 + 3x_3 = 2$$

If found consistent, solve by the Gauss Jordan method.

[Marks-15]

b. Let  $A$  be the non-singular matrix  $\begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$  and let  $T$  be the triangle with vertices  $(1, 1)$ ,  $(-2, 2)$  and  $(2, -3)$ . Describe the image of the triangle  $T$  under the matrix transformation  $f: \mathbb{R}^2 \rightarrow \mathbb{R}^2$  defined by  $f(u) = Au$ .

[Marks-15]

[CLO2]

20  
20

Q2. a. Use the substitution scheme and the matrix  $\begin{bmatrix} 1 & 2 \\ 0 & 3 \end{bmatrix}$  code the message WORK

HARD.

[Marks-10]

b. Use the matrix of Q2. Part a. above, decode the message 33 36 31 33 31 39 41  
60 46 57.

[Marks-10]

Q3. a. Let  $W$  be the subset of  $R^3$  consisting of all vectors of the form  $\begin{bmatrix} a \\ b \\ c \end{bmatrix}$ , where

$b = 2a + 1$ . **Examine**  $W$  is a subspace of  $R^3$  or not ?

[CLO2]  $\frac{20}{25}$

10

[Marks-12]

b. If possible, **determine** a diagonal matrix similar to the following matrix:

$$\begin{bmatrix} -2 & 2 \\ 2 & 1 \end{bmatrix}$$

10

[Marks-13]

$$(\lambda I_2 - A) X = 0$$

[CLO2]  $\frac{15}{25}$

Q4. a. **Examine** whether the vectors

$$p_1(t) = 3t + 1, p_2(t) = 3t^2 + 1, p_3(t) = 2t^2 + t + 1$$

10

in  $P_2$  are linearly independent or linearly dependent ?

[Marks-12]

b. A manufacturer produces two items  $X$  and  $Y$ .  $X$  needs 2 hours on machine A and 2 hours on machine B.  $Y$  needs 3 hours on machine A and 1 hour on machine B. If machine A can be run for a maximum of 12 hours per day and machine B for 8 hours per day and profits from  $X$  and  $Y$  are Rs. 4 and Rs. 5 per item, respectively. **Formulate** the problem as a linear programming problem and find how many units of each item should be manufactured to maximize the profit ?

[Marks-13]  
5



**Department of Basic Sciences & Islamiat**  
**University of Engineering and Technology Peshawar**  
**Computer System Engineering**

Mid Term Examination 3<sup>rd</sup> Semester Fall– 2021

Paper: **Linear Algebra (BSI-111)**

Maximum Marks: 100

Time: 2 Hours

Note: Attempt all questions. A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit.

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Q1. **Discuss** the consistency of the following system of linear equations

$$2x - y + 3z = 3$$

$$3x + y - 5z = 0$$

$$4x - y + z = 3$$

If found consistent, solve by the Gauss Elimination method.

[Marks-15] [CLO1]

Q2. **Describe** the geometry of the matrix transformation  $f: R^2 \rightarrow R^2$  defined

by  $f(u) = Au$  for the matrix  $A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$  [Marks-15] [CLO1]

Q3. **a.** An oil refinery produces low- sulfur and high-sulfur fuel. Each ton of low-sulfur fuel requires 5 minutes in the blending plant and 4 minutes in the refining plant; each ton of high-sulfur fuel requires 4 minutes in the blending plant and 2 minutes in the refining plant. Suppose the blending plant is available for 3 hours and the refining plant is available for 2 hours. **Construct** a mathematical model to the above situation in the form of system of linear equations and find how many tons of each type of fuel should be manufactured so that the plants are fully used?

[Marks-15] [CLO2]

**b.** **Determine** the quadratic interpolant to the following set of data:

$\{(0, 2), (1, 5), (2, 14)\}$ .

[Marks-20] [CLO2]

**P.T.P**

Q4. a. Solve the following linear system of equations by the LU-factorization method

$$3x_1 + 2x_2 = 14$$

$$12x_1 + 13x_2 + 6x_3 = 40$$

$$-3x_1 + 8x_2 + 9x_3 = -28$$

[Marks-20] [CLO2]

b. If possible, find the inverse of the following matrix by using elementary row operations:

$$A = \begin{bmatrix} 2 & 1 & -1 \\ 0 & 2 & 1 \\ 5 & 2 & -3 \end{bmatrix}$$

[Marks-15] [CLO2]

**DEPARTMENT OF BASIC SCIENCES AND ISLAMIAT**  
**University of Engineering and Technology, Peshawar**

**Paper : Complex Variables and Transforms (BSI-362)**  
**Mid-Term Examination Fall-2021**  
**(Computer System Engineering)**

**Time Allowed: 2 hours**

**Max Marks: 20**

**Note: Attempt all questions:**

**Question No 1 (CLO-1, PLO-1, 3+2)**

- (a) Find all roots in the complex plane  $\sqrt[3]{1-i}$ .
- (b) Determine and sketch the graph of complex plane  $\operatorname{Re}(z) \leq -1$

**Question No 2 (CLO-1, PLO-1, 2+3)**

- (a) Show that  $f(x) = \operatorname{Im}(z)$  is not differentiable.
- (b) Find "a" so that the given function is harmonic  
and find a harmonic conjugate  $u = e^{-\pi x} \cos y$

**Question No 3 (CLO-2, PLO-2, 2+3)**

- (a) Find all solutions in the complex plane  $e^z = 1$
- (b) Find all solutions in the complex plane  $\sinh z = 0$

$$\frac{z^{2+1}}{2} \lambda x^{\lambda-1}$$

**Question No 4 (CLO-2, PLO-2, 2+3)**

- (a) Find the principal value of  $(1+i)^{1-i}$
- (b) Find  $\int_C \operatorname{Re}(z) dz$  where C is shortest path from  $1+i$  to  $5+3i$



Q1. ✓

Find the Thevenin equivalent circuit of the ac circuit shown in Figure 1.

Marks 20

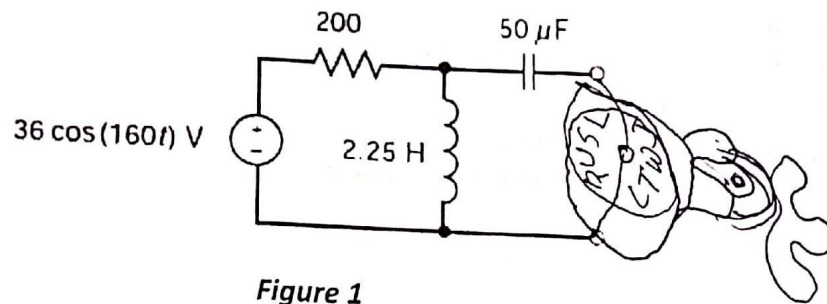


Figure 1

Q2.

A customer's plant has two parallel loads connected to the power utility's distribution lines. The first load consists of 50 kW of heating and is resistive. The second load is a set of motors that operate at 0.86 lagging power factor. The motors' load is 100 kVA. Power is supplied to the plant at 10,000 volts rms. Determine the total current flowing from the utility's lines into the plant and the plant's overall power factor.

Marks 20

Q3

- a. A 4-kW, 110-Vrms load, as shown in Figure 3a, has a power factor of 0.82 lagging. Find the value of the parallel capacitor that will correct the power factor to 0.95 lagging when  $\omega = 377$  rad/s.

Marks 10+10

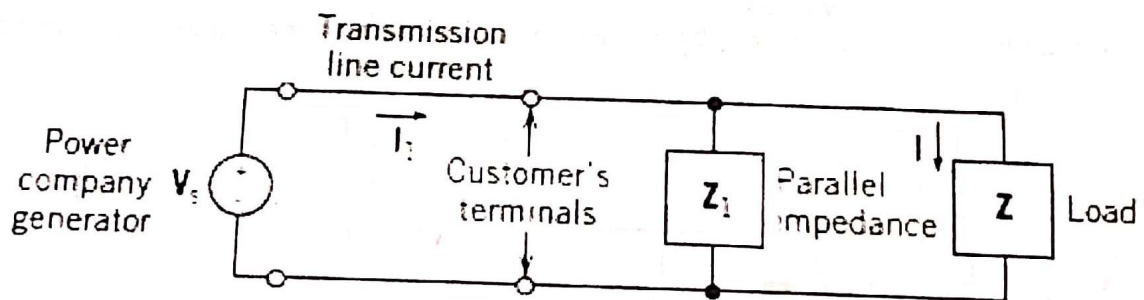


Figure 3a

- b. For the circuit of Figure 3b, find  $Z_L$  to obtain the maximum power transferred when the Thevenin equivalent circuit has  $V_t = 80 \angle 0^\circ$  V and  $Z_t = 12 + j16 \Omega$ . Also, determine the maximum power transferred to the load.

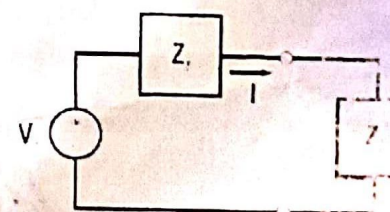


Figure 3b

#### Q4. C5 (Synthesis) PLO 3 (Design/Development of Solutions)

Marks 20

Consider the circuit shown in Figure 4a. The input to the circuit is the voltage of the voltage source  $v_i(t)$ . The output is the node voltage at the output terminal of the op amp  $v_o(t)$ . The network function that represents this circuit is  $H(\omega) = \frac{V_o(\omega)}{V_i(\omega)}$ . The corresponding magnitude Bode plot is also shown in Figure 4b. Design the circuit by finding the proper values of capacitances  $C_1$  and  $C_2$ .

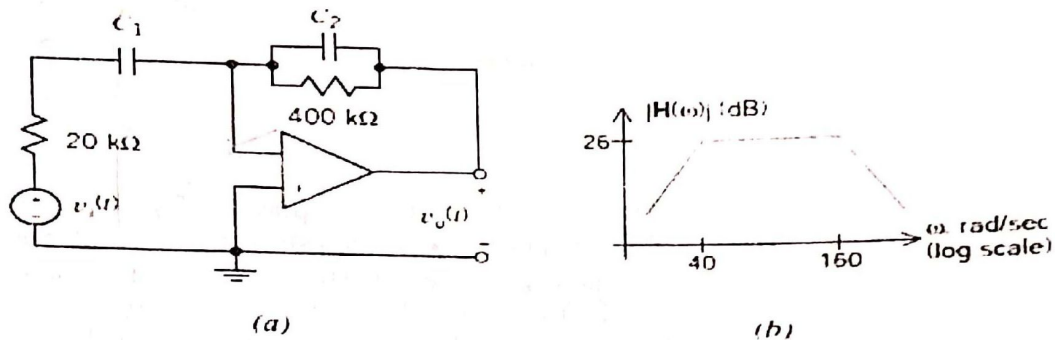


Figure 4

#### Q5. C4 (Analysis) PLO 2 (Problem Analysis)

Consider the circuit shown in Figure 5. The input to the circuit is the voltage of the voltage source 24 V. The output of this circuit, the voltage across the capacitor, is given by  $v_o(t) = 16 - 12e^{-0.6t}$  V when  $t > 0$ .

Analyze the circuit using Laplace Transform and determine the value of the capacitance C.

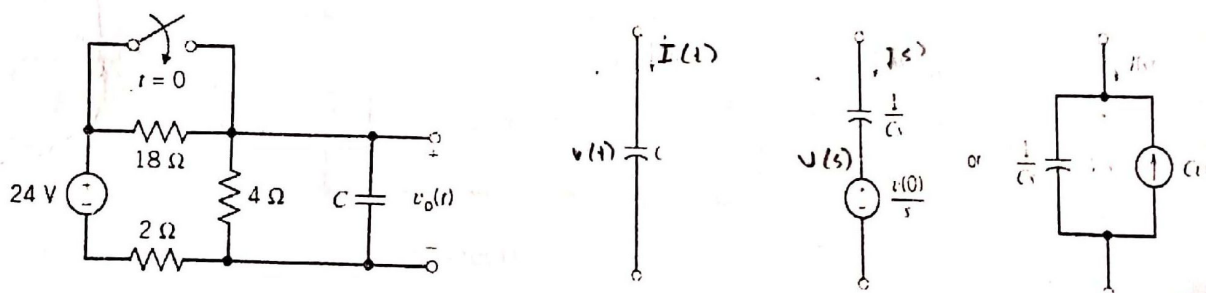
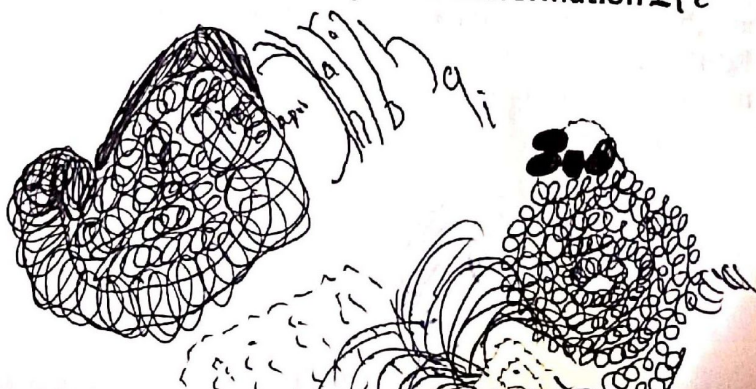


Figure 5

Time-Domain and Complex Frequency-Domain representations of Capacitor

$$\{\text{Use Transformation } \mathcal{L}\{e^{-at}\} \rightarrow \frac{1}{s+a}\}$$





Circuits and Systems 2  
Mid Term Exam Fall 2021

Q1. The output of the circuit shown in Figure 1 is  $v_o$ . The inputs are  $v_1$  and  $v_2$ . Express the output as a function of the inputs and the resistor resistances.

Marks 10

Marks 10

Q2. The circuit shown in Figure 2 has three inputs:  $v_1$ ,  $v_2$ , and  $v_3$ . The output of the circuit is  $v_o$ . The output is related to the inputs by  $v_o = av_1 + bv_2 + cv_3$  where  $a$ ,  $b$ , and  $c$  are constants. Determine the values of  $a$ ,  $b$  and  $c$ .

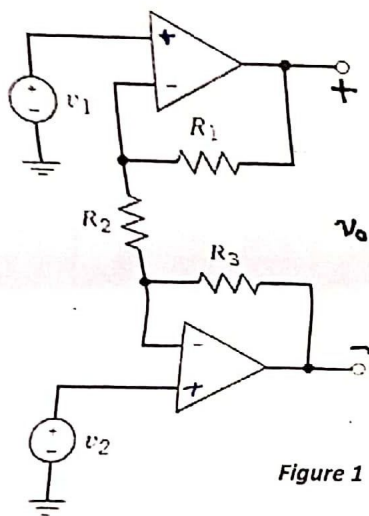
Marks 10

Q3. Write mesh equations for the network of Figure 3 and express them in the matrix form. Write expression for the current in the loop containing the voltage source. Marks 10

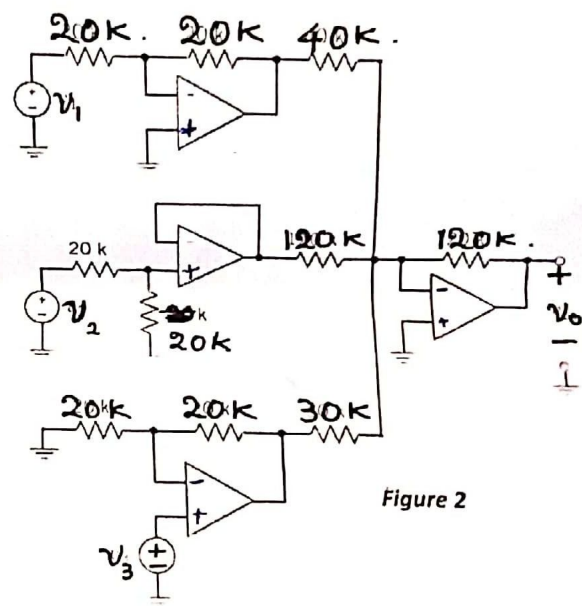
Marks 10

Q4. Determine the Thevenin equivalent circuit for the circuit shown in Figure 4 when  $v_s = 5\cos(4000t - 30^\circ)$  volts.

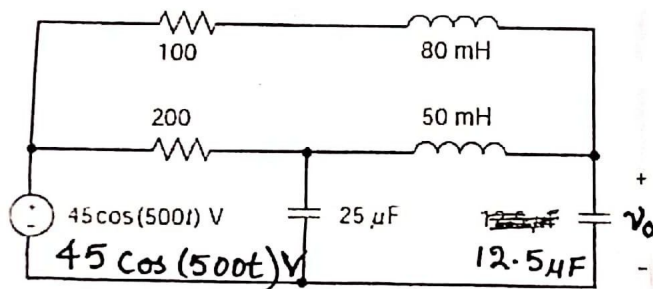
Marks 10



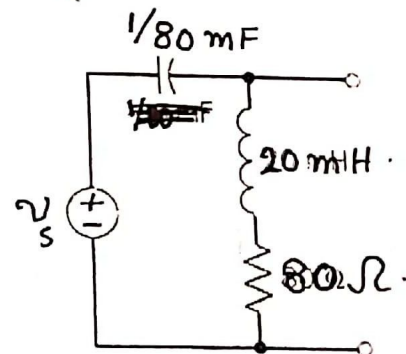
**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**

END

$$\begin{array}{r} 8 \\ \times 5 \\ \hline 40 \end{array}$$

2500

500  
0.5  
25.00

$$\begin{array}{r} 500 \\ \times 2.5 \\ \hline 2500 \\ 10000 \\ \hline 12500 \\ 101.5 \\ \hline 125000 \end{array}$$