

International Islamic University Chittagong  
 Department of Electrical and Electronic Engineering  
 B. Sc. Engineering in EEE  
 Semester End Exam, Spring 2023

Course Code: MATH- 2409  
 Time: 2 hours 30 minutes

Course Title: Mathematics IV

Full Marks: 50

- (i) The figures in the right-hand margin indicate full marks  
 (ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

| Course Outcomes (COs), Program Outcomes (POs) and Bloom's Levels (BL) of the Questions |  |            |       |         |          |        |
|--|--|------------|-------|---------|----------|--------|
| CO   | CO Statements  | PO         | BL    |         |          |        |
| CO1  | Reflect a basic understanding on Complex numbers and their properties, Analytic function, Cauchy-Riemann Equation. Complex Transformations, Complex Integration, Cauchy's integral theorem & formula, Liouville's and Taylor's theorem.      | POa        | C2    |         |          |        |
| CO2  | Apply complex variable, Residue & Residue theorem for solving Contour integration. Developing ability to be manipulate and identify the Laplace transforms & Laplace transforms of derivatives.  | POa        | C3,C6 |         |          |        |
| CO3  | Analyze and demonstrate the basic idea of Fourier series, Fourier & Z-transforms. Develop the convolution theorem for evaluating inverse Laplace transform and demonstrate the basic proficiency of Unit Step, Impulse & Periodic functions. | POa        | C3,C5 |         |          |        |
| Bloom's Levels(BL) of the Questions  |  |            |       |         |          |        |
| Letter Symbols   | C1   | C2         | C3    | C4      | C5       | C6     |
| Meaning  | Remember   | Understand | Apply | Analyze | Evaluate | Create |

**Part A**

[Answer the questions from the followings]

1. a) If  $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$  then find its residue at  $z = 1$  of order 4. CO2 C6 5
1. b) By applying residual calculus derive the following integral: CO2 C3 5

$$J = \int_{\theta=0}^{2\pi} \frac{d\theta}{5 - 3\cos\theta}$$

2. a) If  $L\{F(t)\}=f(s)$  then prove that  $L\{F''(t)\} = s^2f(s) - sF(0) - F'(0)$  CO2 C3 5
- b) Evaluate  $L\{t\}$  and  $L\{t\cos ct\}$  CO2 C3 5

Or

2. a) If the governing equation of  $L - C$  is defined by  $L \frac{d^2q}{dt^2} + \frac{q}{c} = v$  for the Figure-1. Subsequently develop a solution by applying the Laplace transformation for the parameters  $L = 1H, C = 1F, q(0) = 0, q'(0) = 1$  and  $v(t) = 1$ . CO2 C3 5

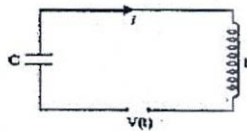


Figure 1: L -C circuit.

2. b) Evaluate  $L^{-1}\left\{\frac{s+4}{s(s-1)(s^2+4)}\right\}$  CO2 C3 5

**Part B**

[Answer the questions from the followings]

3. a) Explain the periodic signal function in time domain and derive the following unit-step function  $f(t)$ . Consequently transform the unit-step function from the time domain to  $s$  domain by applying the Laplace transformation:
- $$f(t) = \begin{cases} 8, & \text{when } t < 3 \\ 2, & \text{when } t \geq 3. \end{cases}$$
3. b) By using convolution theorem to evaluate  $L^{-1} \left\{ \frac{s^2}{(s^2+a^2)(s^2+b^2)} \right\}; a \neq b$  CO3 C5 5
4. a) Explain the Physical significance of Fourier Series. Illustrate the Fourier Series for the function  $f(x) = x$  for  $0 < x < 2\pi$  and sketch its graph from  $x = -4\pi$  to  $x = 4\pi$  CO3 C5 5
4. b) From the Fourier series, to determine  $a_0$  and  $b_n$  CO3 C3 5
5. a) Evaluate the Fourier sine and cosine transform of :  $f(x) = 4e^{-4x}$  CO3 C3 5
5. b) Define  $Z$ -transformation. If  $\{f(k)\} = \{13i, 0, 7, 1, -1, 0, 3, 9\}, k = 0, 1, \dots, 7$  and  $\{g(k)\} = \{13i, 0, 7, 1, -1, 0, 3, 9\}, k = -1, 0, 1, 2, \dots, 6$  are the sequence, where  $\uparrow$  define the index position of the sequence then find its,  $z$ -transformation.

Or,

5. a) Evaluate the Fourier sine and cosine transform of :  $f(x) = e^{-ax}$ . And also determine the  $Z$ -transform of the sequence  $\{a^k\}$ , where  $k \geq 0$  CO3 C3 5
5. b) Express the signals shown in Figure-2 in terms of unit impulse functions and hence find its  $z$ -transformation: CO3 C3 5

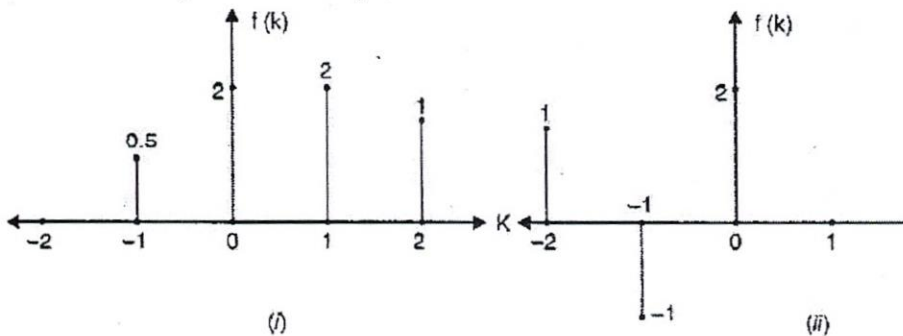


Figure 2: Signal profile in the time domain.

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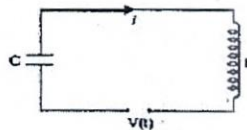


Figure 1: L -C circuit.

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**Part B**

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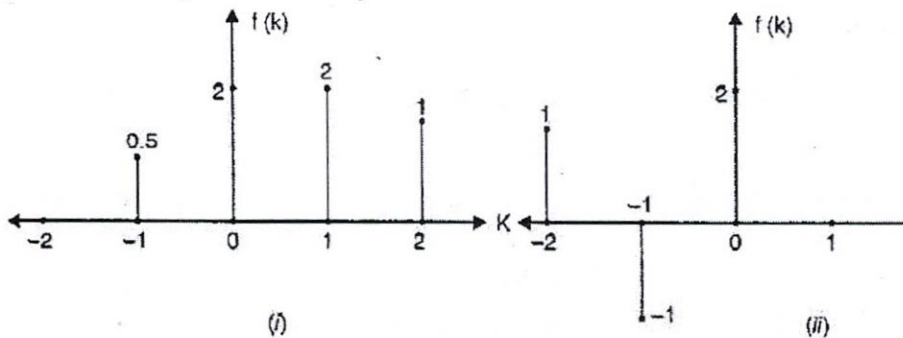


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