International Islamic University Chittagong (IIUC)
Department of Computer Science and Engineering (CSE)
Semester Final Examination

Program: B. Sc. in CSE	Semester: Autumn-2023
Course Code: MATH-2407	Course Title: Mathematics-IV
Time: 2:30 hours	Total Marks: 50

(i) Answer all the questions. The figures in the right-hand margin indicate full marks.
(ii) Separate answer script must be used for separate group.
(iii) Course Learning Outcomes (CLOs) and Bloom's Levels are mentioned in additional Columns.

Course Learning Outcomes (CLOs) of the Questions

CLO1	Demonstrate the understanding of the basic principles and operations set theory, complex numbers, geometrical interpretation complex functions and the concept of transformation in a complex plane.
CLO2	Apply the concept of transformation of an object into complex space and operation of complex functions
CLO3	Use Fourier series, Laplace's Transforms, Fourier Transform in different scenario.
CLO4	Analyze the harmonics & spectrum of different types of waves.
CLO5	Demonstrate the harmonic analysis using MATLAB.

Bloom's Taxonomy Domain Levels of the Questions

| Letter Symbols	R	U	Ap	An	E	C
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Group-A

		Mark	CLO	DL
1.	If $y = f(t) = t^2$ over the integral $-\pi < t < \pi$ and has period 2π. Here, $T = 2L = 2\pi \therefore L = \pi$			
a)	Find the Fourier series for the above function.	5	CLO3	U
b)	Hence, deduce $\dfrac{1}{1^2} - \dfrac{1}{2^2} + \dfrac{1}{3^2} - \dfrac{1}{4^2} + - - - - - = \dfrac{\pi^2}{12}$	3	CLO3	U
c)	Write down the complex form of Fourier series.	2	CLO1	R
2. a)	Evaluate the convolution sums of $y[n] = x[n] * h[n]$ Where,	6	CLO4	U

$$x[n] = \begin{cases} 1, & n = 0 \\ 3, & n = 1 \end{cases} \quad and \quad h[n] = \begin{cases} 2, & n = 0 \\ 1, & n = 1 \end{cases}$$

Where, n represents the time index.

Or

Find the convolution integral of x(t) * y(t)
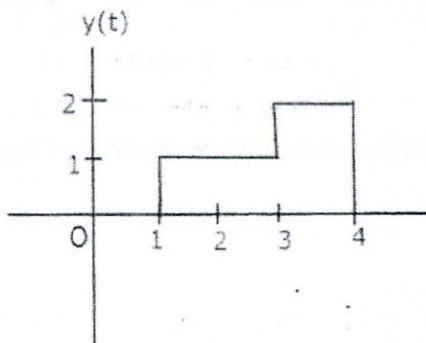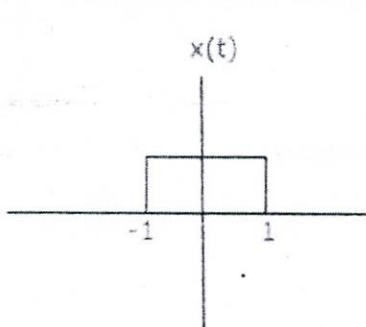
b)

i. If $x = \cos 4t + \frac{1}{3}\sin 4t$ then find the amplitude of the new signal and the phase shift.

ii. Is there any difference in line spectrum in Fourier series and Fourier transform? What kind of difference? And why?

Or

Plot the line (at least 4) spectrum for the following complex wave

$$f(t) = \frac{\pi}{2} + \sum_{n=1}^{\infty} \frac{1}{2n-1}\cos nt + \sum_{n=1}^{\infty} \frac{(-1)^n}{2n}\sin nt$$

2+2=4	CLO4	An
4	CLO4	An

Group-B

			Mark	CLO	DL
3.	**a)**	Find the Fourier transform of the function,	5	CLO3	Ap

$$f(t) = \begin{cases} 1, & 0 < t < 1 \\ -1, & -1 < t < 0 \\ 0, & otherwise \end{cases}$$

Or

Find the Laplace transform of the functions $f(t) = \cos at$

	b)	Express the following function in terms of unit step functions and find its Laplace transform:	5	CLO3	Ap

$$f(t) = \begin{cases} 10; & t \le 3 \\ 8; & t \ge 3 \end{cases}$$

Or

Solve the following Initial Value Problem (IVP) by Laplace Transform

$$Y'' + 4Y = 12t \qquad Y(0) = 0 \qquad Y'(0) = 7$$

4.	**a)**	Evaluate $\mathcal{L}\left\{\frac{\sin 2t}{t}\right\}$ using the division theorem.	5	CLO3	Ap
	b)	Draw the Impulse Function $2 * \delta(t-3)$	1	CLO3	U
	c)	Draw the Function $x(t) = r(t+1) - r(t) + r(t-2)$	4	CLO3	U
5.	**a)**	Write down a user defined function in MATLAB to reconstruct $f(t)$ in the time interval of **[-4, 20]** for the following complex wave	5	CLO5	An

$$f(t) = 10 + \frac{10}{3\pi}\left(\sin\frac{\pi t}{4} + \frac{1}{3}\sin\frac{3\pi t}{4} + \frac{1}{5}\sin\frac{5\pi t}{4} + \frac{1}{7}\sin\frac{7\pi t}{4} + \cdots\right)$$

	b)	Write down MATLAB code for the following function:	3	CLO5	An

$$x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-4)$$

	c)	If	2	CLO5	An

$$x[n] = 2 \quad ; \ n = 0 \qquad\qquad h[n] = \quad 2 \ ; \ n = 0$$
$$\qquad = 6 \ ; \ n = 1 \qquad\qquad\text{and}\qquad\qquad = -2 \ ; \ n = 1$$

Write MATLAB code to find the convolution sum of the above signals.