M.Tech (IEE) 1st Year, 2nd Semester, 2024
Subject: Digital Filtering & Control

Full Marks: 100 Time: 3 Hours

Answer any five		
1(a)	Twenty samples from a random sequence are recorded as follows: X = { -1, -2, 4, 4, -8, 0, -1, 7, 11, 12, -8, 1, -12, -11, 0, 16, -7, 4, -2, 12} Using the standard formulae compute the mean and variance of the data. Create seven bins and plot the corresponding histogram on a graph paper.	12+8
2(a)	Assuming a linear relationship (y = mx + c) between the input-output variables for the data set S = {(x1, y1) ..... (xn, yn)}, deduce the working formulae for the Least Square Estimator that computes the estimates of m and c.	10
2(b)	An experiment yields the following input-output observation data set: S = {(0, 5.1), (1, 7.12), (2, 8.91), (3, 11.26), (4, 12.87), (5, 15.17)}. Assuming a linear input-output relationship deduce the best-fit linear relationship between input and output.	10
3(a)	A linear system is defined by the equation y = a1.x + a2 + n, where n is a normally distributed zero-mean measurement noise with standard deviation σ. Define the log Maximum Likelihood Function and derive the expressions for estimates of a1, a2 and σ.	10
3(b)	The output of a linear system is corrupted with a normally distributed zero-mean measurement noise. For the experimental I/O data set of {(2, 19.88), (4, 72.15), (6, 155.96), (8, 272.18), (10, 419.85)}, use an MLE to find the estimates of the slope and intercept of the best-fit line and the standard deviation of the measurement noise.	10
4(a)	With examples explain the homogeneity and additivity properties of a linear system	5+5
49b)	What is meant by shift invariance and sinusoidal fidelity? Explain with examples.	5+5

Ref: EX/PG/IEE/T/128B/2024

M.Tech (IEE) 1st Year, 2nd Semester, 2024
Subject: Digital Filtering & Control

5(a)	Write a pseudo-code for a convolution machine using the output side algorithm.	8
5(b)	An input signal x[10] = [1, 2, 1, 0, -1, -2, -1, 0, 1, 2] is passed through a filter kernel with an impulse response of h[4] = [0.6, 0.3, 0.1, 0]. Generate the output y[n] using the algorithm coded in 5(a).	12
6	Briefly describe the functioning of the following functions: • Delta function • Shift function • Discrete derivative • Discrete integral	5x4 = 20
7	Briefly explain, with a suitable example, the concept of building a cross-correlation machine. How does it differ from a convolution machine?	15+5