QP Code: R252B059 | Reg. No | | | | | | | | | | | AY 24

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

M.Tech. (Second Semester) Regular Examinations, July – 2025

24MECPC12002 - Advanced Digital Signal Processing

(ECE)

Time: 3 hrs | Maximum: 60 Marks

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

	Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a.	Explain the concept of characterization in time and frequency domains in the context of digital signal processing.	CO1	K2
b.	Differentiate between FIR and IIR filters based on their characteristics and applications.	CO1	K2
c.	Explain the concept of multi-rate DSP and its significance in signal processing applications.	CO2	K1
d.	What is the LMS (Least Mean Squares) algorithm, and how is it applied in adaptive filtering?	CO4	K3
e.	Define ARL (Average Run Length) and explain its role in signal detection.	CO3	K2

PART – B **(10 x 5 = 50 Marks)**

	Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2.a	Explain the principles behind Fast Fourier Transform (FFT) algorithms, including the Radix-2 algorithm and its variants.	5	CO1	K3
b	How does the representation of signals differ in bandpass and lowpass domains? Provide real-world examples.	5	CO1	K2
	(OR)			
c	Describe the role and implementation challenges of sub-band coding in speech and image compression applications.	5	CO1	K3
d	Explain the design and application of FIR filters using windowing techniques with examples.	5	CO1	K3
3.a	Describe the functionalities of decimators and interpolators in multi-rate signal processing systems.	5	CO2	K3
b	Discuss the process of sampling rate conversion in DSP, including its algorithms and applications.	5	CO2	K4
	(OR)			
c	Explain the concept of minimum-variance spectral estimation and its significance in spectrum estimation tasks.	5	CO2	K3
d	Discuss wavelet transform-based approaches for non-stationary signal analysis and their advantages.	5	CO2	K4
4.a	Discuss Wiener filters and their mathematical formulation, applications, and limitations with relevant examples.	5	CO3	K5
b	Explain the characteristics and implications of a stationary random process in signal processing.	5	CO3	K3
	(OR)			

c	Explain the concept of optimum linear filters and the MMSE criterion for filter optimization.	5	CO3	K2
d	Provide a comparative analysis of parametric vs. non-parametric spectral estimation techniques with examples.	5	CO3	K3
5.a	Explore the concept of adaptive filters in depth, including their principles, capabilities, and limitations.	5	CO4	K2
b	Discuss how the criterion is used to derive adaptive filter algorithms such as LMS and RLS.	5	CO4	K2
	(OR)			
c	Analyze the role of LMS algorithm in adaptive filter convergence and stability.	5	CO4	K3
d	Explain the application of adaptive filtering in echo cancellation with real-world scenarios.	5	CO4	K4
6.a	Explain the fundamentals of Digital Signal Processing (DSP) and its significance in modern signal processing applications.	5	CO1	K2
b	Explain techniques such as periodogram, Welch's method, AR modeling, and MV spectral estimation in spectrum analysis.	5	CO1	K3
	(OR)			
c	Describe the structure and convergence analysis of the RLS (Recursive Least Squares) algorithm.	5	CO4	K5
d	Discuss filter structure selection impact on performance in real-time DSP hardware implementations.	5	CO4	K4

--- End of Paper ---