GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

M.Tech. (First Semester) Regular Examinations, February – 2025

24MVLPE11021 –Real-time Signal Processing Systems

ECE(VLSI Design)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions

(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.	How is the Fast Fourier Transform useful in representing a signal?	CO4	K2
b.	What are the real-life applications of FFT?	CO1	K1
c.	What is the design process of an Infinite Impulse Response (IIR) filter?	CO2	K2
d.	What is radix-2 FFT?	CO1	K2
e	How does windowing affect the frequency response of a signal?	CO3	K1

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions

		Marks	CO #	Blooms Level
2. a.	Explain the impact of spectral leakage in Fourier analysis, detailing its causes, effects, and the role of windowing techniques in reducing its influence on frequency representation.	5	CO1	K3
b.	Discuss the principles of multirate signal processing, covering techniques such as interpolation, decimation, and polyphase decomposition, and their benefits in optimizing signal processing efficiency.	5	CO1	K3
	(OR)			
c.	Compare FIR and IIR filters, emphasizing their mathematical models, stability considerations, frequency response characteristics, and applications across various digital signal processing fields.	5	CO1	K4
d.	Describe the structural design of the Direct Form II implementation in digital filters, analyzing its computational benefits and memory efficiency.	5	CO1	K2
3.a.	Elaborate on the significance of the Nyquist-Shannon sampling theorem, explaining its mathematical basis, its role in preventing aliasing, and its importance in modern signal processing systems.	5	CO2	K3
b.	Analyze the differences between the Discrete Fourier Transform (DFT) and the Fast Fourier Transform (FFT), focusing on computational efficiency, real-world applications, and their behaviour in large data processing.	5	CO2	K2
	(OR)			
c.	Explain how the windowing method is used in digital filter design, comparing different window functions, their influence on filter characteristics, and the trade-offs in performance.	5	CO2	K3
d.	Discuss the role of adaptive filtering in digital signal processing, covering LMS and RLS algorithms, their advantages, and their importance in real-time signal applications.	5	CO2	K4
4.a.	Provide a detailed analysis of finite word length effects in digital filters, examining quantization errors, coefficient rounding, and their consequences in fixed-point and floating-point processing systems.	5	CO3	K2

b.	Compare the design methodologies of cascade and parallel structures in digital signal processing, evaluating their stability, efficiency, and implementation strategies.	5	CO3	K3
	(OR)			
c.	Explain why the Fast Fourier Transform (FFT) is termed "fast," highlighting its algorithmic structure, computational improvements, and its significance in real-time applications.	5	CO3	K2
d.	Differentiate between decimation and interpolation in DSP, explaining their mathematical basis, real-world implementations, and how they modify signal characteristics.	5	CO3	K3
5.a.	Discuss the trade-offs between time-domain and frequency-domain representations of signals, detailing their respective strengths, limitations, and practical applications.	5	CO4	K4
b.	Provide an in-depth explanation of the relationship between the Discrete Fourier Transform (DFT) and the Z-transform, emphasizing their connections and roles in analyzing signals and systems.	5	CO4	K3
	(OR)			
c.	Examine the concept of signal reconstruction from sampled data, detailing interpolation methods and their role in minimizing distortion and maintaining signal fidelity in digital communication systems.	5	CO4	K1
d.	Analyze the architecture of the TMS320C6713 DSP processor, describing its core components, instruction set, and real-time processing capabilities.	5	CO4	K2
6.a.	Discuss the advantages and limitations of the Fast Fourier Transform (FFT) in signal analysis, covering its computational complexity, efficiency, and constraints.	5	CO2	K3
b.	Examine the concept of zero-padding in FFT, exploring how it enhances spectral resolution and contributes to improved frequency domain interpolation.	5	CO1	K3
	(OR)			
c.	Explain the nature of quantization error in digital signal processing, discussing its origins, impact on signal accuracy, mathematical modeling, and techniques to mitigate its effects.	5	CO1	K1
d.	Describe the role of convolution in digital signal processing, explaining its mathematical foundation, implementation in discrete-time systems, and significance in linear time-invariant system analysis.	5	CO3	K3

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