Reg. No.																

Question Paper Code	14717

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Fifth Semester

Electronics and Instrumentation Engineering

(Common to Instrumentation and Control Engineering)

20EIPC503 - DIGITAL SIGNAL PROCESSING

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Nyquist sampling theorem is mainly used to avoid: a) Quantization b) Aliasing c) Convolution d) Modulation	1	K1	CO1
2.	Infer whether the signal $x[n] = \cos\left(\frac{\pi n}{4}\right)$ is periodic or aperiodic. a) Aperiodic b) Periodic c) Random d) Energy signal	1	K2	CO1
3.	Solve and identify the nature of the system represented byy[n]=x[2n] a) Time invariant b) Time varying c) Stable only d) Linear and invariant	1	K3	CO1
4.	Interpret the significance of convolution in DSP systems. a) Frequency shifting b) System output calculation c) Quantization noise removal d) Signal encoding	1	K2	CO2
5.	Recall the mathematical operation used to determine output of an LTI system. a) Correlation b) Convolution c) Modulation d) Sampling	1	K1	CO2
6.	Apply pole location concept to identify the system nature forz=1.2 a) Stable b) Unstable c) Dynamic d) Memoryless	1	K3	CO2
7.	Define the twiddle factor used in FFT computation. a) $e^{j2\pi N}$ b) $e^{-j2\pi/N}$ c) $e^{-j2\pi kn/N}$ d) $e^{j\pi/N}$	1	K1	CO3
8.	Classify the transform property associated with energy conservation. a) Circular convolution b) Parseval's theorem c) Linearity d) Time reversal	1	K2	CO3
9.	Solve the number of butterfly operations required in a 16-point radix-2 FFT. a) 4 b) 16 c) 8 d) 32	1	K3	CO3

10.	Recall the transformation used for analog-to-digital filter conversion without aliasing. a) Impulse invariant transformation b) Bilinear transformation c) Fourier transform d) Z-transform	*1*	*K1*	*CO4*
11.	Infer the relationship between main lobe width and transition bandwidth. a) Wider main lobe gives sharper transition b) Narrower main lobe gives sharper transition c) No relation exists d) Wider main lobe removes ripples	*1*	*K2*	*CO4*
12.	Determine the suitable window for better side lobe attenuation. a) Rectangular window b) Hamming window c) Impulse window d) Unit window	*1*	*K3*	*CO4*
13.	Which unit is mainly responsible for high-speed arithmetic computation in DSP processors? a) DMA controller b) MAC unit c) Interrupt controller d) Cache memory	*1*	*K1*	*CO5*
14.	Infer the purpose of on-chip memory in DSP processors. a) Increased processing delay b) Faster memory access c) Reduced arithmetic operations d) Elimination of instruction execution	*1*	*K2*	*CO5*
15.	Identify the effect of using separate program and data memories in DSP processors. a) Increased memory conflict b) Simultaneous instruction and data access c) Reduced execution speed d) Increased quantization noise	*1*	*K3*	*CO5*
16.	Solve for the decimal equivalent of the bit-reversed binary sequence0110_2 a) 3 b) 5 c) 6 d) 9	*1*	*K3*	*CO5*

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	Apply the concept of causality to determine whether the following system is causal or non-causal: y[n]=x[n]+x[n+2]	*3*	*K3*	*CO1*
18.	Compare energy signals and power signals based on mathematical properties and practical applications.	*3*	*K4*	*CO1*
19.	Apply inverse Z-transform to determine the time-domain sequence for: $X(z) = \frac{1}{(1-0.5z^{-1})(1-0.2z^{-1})}$	*3*	*K3*	*CO2*
20.	Solve for the DTFT of the sequence x[n]={1,2,3,4}	*3*	*K4*	*CO2*
21.	Apply circular convolution for the sequences x[n]={1,2,1,2} and h[n]={1,−1,1,−1}.	*3*	*K3*	*CO3*
22.	Solve the analog frequency corresponding to the digital frequency$\omega=\pi/2$ rad/sample,T=0.5s	*3*	*K4*	*CO4*
23.	Identify the Butterworth filter order required for the following specifications: Passband attenuation:αp=3 dB Stopband attenuation:αs=18 dB Passband frequency:Ωp=1 rad/s Stopband frequency:Ωs=2 rad/s	*3*	*K3*	*CO4*
24.	Apply DSP processors to explain the processing steps involved in real-time audio signal enhancement systems.	*3*	*K3*	*CO5*

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25.	a)	Examine the following systems and classify them as linear/nonlinear, causal/noncausal, and stable/unstable: (i) $y[n]=x[n]+x[n-1]$ (ii) $y[n]=x^2[n]$	*12*	*K4*	*CO1*
		OR			
	b)	A signal occupies frequencies from 1 kHz to 7 kHz. (i) Determine the minimum sampling frequency. (ii) Sketch the sampled spectra for: 10 kHz 18 kHz (iii) Analyze spectral overlapping conditions.	*12*	*K4*	*CO1*
26.	a)	Solve Linear convolution between $x[n]=\{1,-1,2\}$ and $h[n]=\{2,1,-1\}$ using graphical and matrix method.	*12*	*K4*	*CO2*
		OR			
	b) (i)	Analyze the ROC and stability for the sequence $x[n]=-(0.75)^n u[-n-1]$	*6*	*K4*	*CO2*
	(ii)	Inspect the differentiation property of DTFT for the sequence $x[n]=nu[n]$ and derive the frequency-domain representation.	*6*	*K4*	*CO2*
27.	a)	Apply DFT and sketch the magnitude and phase spectrum for $x[n] = \cos\left(\frac{\pi n}{4}\right)$	*12*	*K3*	*CO3*
		OR			
	b)	Apply radix-2 DIT FFT for the sequence$x[n]=\{1,0,1,0,1,0,1,0\}$and explain the role of bit reversal.	*12*	*K3*	*CO3*
28.	a)	Construct in detail the design process of low pass digital butterworth filter.	*12*	*K3*	*CO4*
		OR			
	b)	Develop the design of a low-pass FIR filter using Hamming window for Sampling frequency: f_s =8 kHz Cutoff frequency:f_c =2 kHz Filter length: N=9 Determine the filter coefficients and sketch the frequency response.	*12*	*K3*	*CO4*
29.	a)	Explain the architecture and operation of Harvard architecture and Von Neumann architecture in DSP processors, and apply their advantages in real-time signal processing applications with suitable comparisons.	*12*	*K3*	*CO5*
		OR			
	b)	Construct and Explain the architecture of TMS 320C54X processor.	*12*	*K3*	*CO5*