Reg. No.															

Question Paper Code	13559

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Fourth Semester

Artificial Intelligence and Data Science

20AIPC402 - BIOMEDICAL SIGNAL AND IMAGE PROCESSING

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Select the commonly used standard test signal in biomedical signal processing for system analysis. (a) Gaussian white noise (b) Electroencephalogram (EEG) (c) Impulse signal (d) Square wave	1	K1	CO1
2.	Identify the best category that describes an electrocardiogram (ECG) signal. (a) Deterministic and periodic (b) Random and discrete-time (c) Deterministic and a periodic (d) Random and continuous-time	1	K1	CO1
3.	Pick out the bio-potentials generated by the human brain. (a) EMG (b) ECG (c) EOG (d) EEG	1	K1	CO2
4.	Name the commonly used electrode type for surface biopotential measurements. (a) Floating electrode (b) Microelectrode (c) Suction electrode (d) Ag/AgCl electrode	1	K1	CO2
5.	Identify the basic time-domain filtering technique from the given list: (a) Histogram equalization (b) Butterworth filter (c) Median filter (d) Fourier transform	1	K1	CO3
6.	Which filter used to remove high-frequency noise from biomedical signals? (a) Band-pass filter (b) Low-pass filter (c) Notch filter (d) High-pass filter	1	K1	CO3
7.	Find the factor that significantly influences human image perception. (a) Image resolution (b) File compression (c) Memory usage (d) Bit rate	1	K1	CO4
8.	The Modulation Transfer Function (MTF) of the human visual system represents: (a) The ability to perceive color gradients (b) The ratio of input to output frequencies (c) The frequency response of the eye to varying contrasts (d) The eye's lens focusing ability	1	K1	CO4
9.	Identify the commonly used operation to improve the contrast of biomedical images. (a) Spatial transformation (b) Smoothing filter (c) Histogram equalization (d) Edge detection	1	K1	CO5
10.	Infer the geometric operation that helps to correct image distortion due to scanner movement. (a) Image filtering (b) Histogram matching (c) Affine transformation (d) Intensity slicing	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	Draw the step signal with their mathematical expression.	2	K1	CO1
12.	State any one practical application of Ramp signal with its equation.	2	K1	CO1
13.	State all or none law in respect of cell bio potential.	2	K1	CO2
14.	List the types of bioelectric potentials.	2	K1	CO2
15.	List the functions of a moving average filter in signal processing.	2	K1	CO3
16.	How do derivative-based operators help in removing low-frequency artifacts from signals?	2	K1	CO3
17.	Identify the purpose of frequency-domain filtering in signal processing.	2	K2	CO4
18.	What is image perception and why is it important in medical imaging?	2	K1	CO4
19.	Infer the functions of the Modulation Transfer Function (MTF) for the visual system application.	2	K2	CO5

20.		Identify the process of image quantization and its effect does it have on image quality.	*2*	*K1*	*CO5*
21.		Why are image transforms like Fourier Transform used in image processing?	*2*	*K1*	*CO6*
22.		Distinguish between the functions of image restoration and image enhancement.	*2*	*K2*	*CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Given the signal x[n] = [-3,2,0,1,4,5] Draw the following signals. (i) 2x[n+2] (ii) x[n-2]+x[n+3] (iii) x[n/2+3] (iv) x[(n+2)/3]	*11*	*K2*	*CO1*
		OR			
	b)	Classify the following signals based on their characteristics and justify your answers with suitable real-life examples and benefits in signal processing applications. Continuous-Time (CT) or Discrete-Time (DT) Periodic or Aperiodic Deterministic or Random	*11*	*K2*	*CO1*
24.	a)	Write down the 'Nernst Equation' and 'Goldman Equation' and explain about the constants used.	*11*	*K2*	*CO2*
		OR			
	b)	Compare and contrast the working principles, typical waveforms, and signal characteristics of biological amplifiers used in ECG, EEG, EMG, and PCG systems. How do the design requirements of the amplifiers differ based on the type of biological signal being measured?	*11*	*K2*	*CO2*
25.	a)	Explain how Moving Average Filters and Derivative-based Operators are used to remove low-frequency artifacts in signal processing.	*11*	*K2*	*CO3*
		OR			
	b)	Explain the working principles, applications, and advantages of X-ray, CT, MRI, and Ultrasound imaging techniques. Discuss how you would determine the most suitable imaging technique for a specific medical condition.	*11*	*K2*	*CO3*
26.	a)	Apply derivative-based operators used for removing low-frequency artifacts.	*11*	*K3*	*CO4*
		OR			
	b)	Analyze synchronized averaging and moving average filters with suitable examples.	*11*	*K3*	*CO4*
27.	a)	Explain the significance of 2D Discrete Fourier Transform (DFT) in image processing. Explain how it helps in transforming an image from the spatial domain to the frequency domain. Discuss other common image transforms and their applications.	*11*	*K2*	*CO5*
		OR			
	b)	Explain Image fidelity criteria with an example.	*11*	*K2*	*CO5*
28.	a)	Explain the use of wiener filter or least mean square filter in image restoration.	*11*	*K2*	*CO6*
		OR			
	b)	Explain the image degradation model in the context of image restoration and discuss its components and the process of image restoration.	*11*	*K2*	*CO6*