Reg. No. | | | | | | | | | | | | | |

B.E / B.TECH. DEGREE EXAMINATION, MAY 2023

Fifth Semester

AD18502 – DIGITAL SIGNAL PROCESSING FOR DATA SCIENCE

(Artificial Intelligence and Data Science)

(Regulation 2018)

TIME: 3 HOURS **MAX. MARKS: 100**

CO 1 Use of signal modelling.

CO 2 Know various signal transformations.

CO 3 Appreciate necessity of various probability distributions.

CO 4 Design models that can process audio signals.

CO 5 Use existing architectures and create their own architectures for computer vision.

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Define any two mathematical operations performed on a continuous – time signal.	**1**	**1**
2.	Let $x(t) = \cos(\omega_x(t + \tau_x) + \theta_x)$. Determine the frequency in hertz and the period x(t) for the $\omega_x = 3\pi/4, \tau_x = 1/2, \theta_x = \pi/4$	**1**	**2**
3.	Determine the z transform of the $\left(\frac{1}{3}\right)^n u(n)$ and sketch the pole – zero plots and indicate the ROC on your sketch.	**2**	**2**
4.	Write down the relationship between z transform and discrete time fourier transform	**2**	**2**
5.	Define the term binomial distribution.	**3**	**1**
6.	A basketball player can shoot a ball into the basket with a probability of 0.6. What is the probability that he misses the shot?	**3**	**2**
7.	Mention the advantages and disadvantages of Large Vocabulary Continuous Speech Recognition (LVCSR).	**4**	**2**
8.	Define the term Autocorrelation.	**4**	**1**
9.	Name the techniques involved in object detection and tracking.	**5**	**2**
10.	Define the Convolutional Neural Networks (CNN).	**5**	**1**

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11.(a)	**(i)**	Find the convolution of the sequences $x_1(n) = x_2(n) = \{1, 1, 1\}$	**(7)**	**1**	**4**
	(ii)	Determine whether the given signal is Energy, Power or neither $x(t) = e^{-3t}.u(t)$	**(7)**	**1**	**4**
		(OR)			
(b)	**(i)**	Determine whether the following systems are: (1) Memory or Memoryless (2) Time-Invariant, (3) Linear or Non-Linear, (4) Causal or Non-Causal, (5) Stable or Unstable system. (i) $y(t) = x(t)cos\omega_c t$ (ii) $y(n) = x(-n + 2)$	**(7)**	**1**	**4**
	(ii)	Explain in detail the process of converting a digital signal to analog signals. Mention some types of converters that are available to make this conversion process.	**(7)**	**1**	**4**
12. (a)	**(i)**	Find the Z transform of the signal $x(n) = 7(1/3)^n u(n) - 6(1/2)^n u(n)$	**(7)**	**2**	**4**
	(ii)	Find the z transform and associated ROC $x(n) = [r^n cos\omega_o n]u(n)$	**(7)**	**2**	**4**
		(OR)			
(b)	**(i)**	The impulse response of an LTI system is $h(n) = \{1, 2, 2, 1\}$. Find the response of the system for the input $x(n) = \{1, 2, 3, 4\}$.	**(7)**	**2**	**4**
	(ii)	Determine the impulse response $h(n)$ for the system described by the difference equation $y(n) - 4y(n - 1) + 4y(n - 2) = x(n - 1)$	**(7)**	**2**	**4**
13. (a)		Consider two variables x and y with joint distribution $p(x, y)$. Prove the following results. $E(x) = E_y[E_x(x/y)]$ $var(x) = E_y[Var_x(x/y)] + var_y[E_x(x/y)]$	**(14)**	**3**	**3**
		(OR)			

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(b)	Show that as a consequence of there being a finite number of possible assignments for the set of discrete indicator variables r_{nk}, and that for each such assignment there is a unique optimum for the $\{\mu_k\}$, the K-means algorithm must converge after a finite number of iterations.	**(14)**	**3**	**3**
14. (a)	What is the need for feature extraction techniques? Explain in detail about (a) Mel-Frequency Cepstral Coefficient (MFCC) (b) Discrete Wavelet Transform	**(14)**	**4**	**4**
	(OR)			
(b)	**(i)** How audio signals are classified and explain in detail about the k – nearest neighbors (k – NN), decision tree and speech classification.	**(7)**	**4**	**4**
	(ii) How support vector machine can be used for classification as a supervised machine learning algorithm.	**(7)**	**4**	**4**
15. (a)	Explain in detail about the process involved in segmenting and synthesis of an image.	**(14)**	**5**	**3**
	(OR)			
(b)	Illustrate in detail about the operation and pooling process of CNN.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	The weight in grams of beans in a tin is normally distributed with mean μ and standard deviation 7.8. Given that 10% tins contains less than 200g, find (a) the value of μ (b) the percentage of tins that contain more than 225g of beans the machine settings are adjusted so that the weight in grams, of beans in a tin is normally distributed with mean 205 and standard deviation σ.	**(10)**	**3**	**5**

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