Reg. No.

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024
Fifth-Semester
AD18502 – DIGITAL SIGNAL PROCESSING FOR DATA SCIENCE
(Artificial Intelligence and Data Science)
(Regulation 2018 / 2018A)
(Normal Distribution Table permitted)

TIME: 3 HOURS		MAX. MARKS: 100

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Use of signal modelling.	4
CO 2	Know various signal transformations.	4
CO 3	Appreciate necessity of various probability distributions.	3
CO 4	Design models that can process audio signals.	4
CO 5	Use existing architectures and create their own architectures for computer vision.	3

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Determine whether the given discrete time sequence is periodic or not. If the sequence is periodic, find the fundamental period, $x(n)=\cos\left(\dfrac{n}{8}\right)\cos\left(\dfrac{\pi n}{8}\right)$.	1	2
2.	Given the signal x(t) as shown in Fig.1.1. Sketch the following signals: $x(t) = x(2t+3)$	1	2

Fig.1.1

		CO	RBT LEVEL
3.	Give the relationship between z-transform and Discrete Time Fourier Transform.	2	2
4.	Find the Inverse Z-transform of $X(Z) = \dfrac{Z}{(Z+2)(Z+3)}$ using power residue method.	2	1
5.	Define the term Binomial and Multinomial Distribution.	3	1
6.	Estimate the mean equation of Maximum Likelihood for the gaussian distribution.	3	2
7.	Define the term Autocorrelation of basic audio signal.	4	2
8.	Why are Gaussian mixture models replaced by deep neural network in the speech recognition process?	4	2
9.	Infer the features of Convolution Neural Networks (CNN).	5	2
10.	Name the techniques involved in object detection and tracking.	5	2

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL

11. (a) **(i)** Determine whether the given signal is Energy, Power or neither **(7)** **1** **4**

$$x(t) = e^{-3t}.u(t)$$

(ii) Find the Fourier transform of the signal, **(7)** **1** **4**

$$x(n) = ¿ a \vee ¿^{n} ; -1 < a < 1 ¿$$

(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 **(7)** **1** **4**

(i) $y(t)=x(t)\cos\omega_c t$

(ii) $y(n)=x(n)+x(n-1)$

(ii) Explain in detail about the process of converting an analog signal to digital 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 $x(n) = [3(3)^{n}u(n)-4(2)^{n}u(n)]$ **(7)** **2** **4**

(ii) Find the Z transform of the signal and associated ROC: **(7)** **2** **4**

$$x(n) = ¿ ¿)]u(n)$$

(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) **(i)** With appropriate equations, explain in detail about conditional Gaussian distribution and marginal distribution. **(8)** **3** **3**

(ii) The life time of an electric component is normally distributed with mean value of 250 hours and standard deviation of σ hours. Find the value of σ so that the probability of the component to have life between 200 and 300 hours is 0.7 **(6)** **3** **3**

(OR)

(b) What do you mean by K-means Clustering? Elaborate the application with **(14)** **3** **3**

respect to image segmentation and image compression.

14. (a) Explain in detail about the basic audio features: **(14) 4 4**
    (i) Pitch
    (ii) Timbral Features
    (iii) Inharmonicity
    (iv) MPEG-7 features

<div align="center">

(OR)

</div>

(b) How audio signals are classified? Explain in detail about (i) K-Nearest **(14) 4 4**
Neighbour (K-NN), (ii) Bayes Classifier.

15. (a) Intricate on the following terms **(14) 5 3**
    (a) Sparse interactions
    (b) Parameter sharing
    (c) Equivariant representation

<div align="center">

(OR)

</div>

(b) Elaborate in detail about the process involved in Image segmentation and **(14) 5 3**
synthesis.

<div align="center">

PART- C (1 x 10 = 10 Marks)
(Q.No.16 is compulsory)

</div>

	Marks	CO	RBT LEVEL

16. **(i)** Suppose scores on an IQ test are normally distributed. If the test has a **(10) 3 5**
mean of 100 and a standard deviation of 10, what is the probability that
a person who takes the test will score between 90 and 110?

(ii) Molly earned a score of 940 on a national achievement test. The mean
test score was 850 with a standard deviation of 100. What proportion of
students had a higher score than Molly? (Assume that test scores are
normally distributed).

<div align="center">

****

</div>