PAPER ID-310915

Subject Code: BCAI051

Roll No: | | | | | | | | | | | | | |

BTECH

(SEM V) THEORY EXAMINATION 2024-25

MATHEMATICAL FOUNDATION AI, ML AND DATA SCIENCE

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 07 = 14**

Q no.	Question	CO	Level
a.	How is the mode defined in statistics?	1	K2
b.	Define skewness? How does it affect the distribution of data?	1	K1
c.	Describe sampling in the context of inferential statistics?	2	K1
d.	Define a pseudo-random number?	3	K1
e.	Describe a subspace of a vector space.	4	K2
f.	Define the kernel of a linear transformation.	5	K1
g.	With example explain the process of diagonalization of a matrix?	5	K1

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 21**

a.	Explain the concept of dispersion and describe the various measures of dispersion such as range, variance, and standard deviation. How do these measures help in understanding the spread of data?	1	K1
b.	Describe estimation and discuss the difference between point estimation and interval estimation. How does estimation help in making decisions about population parameters based on sample data?	2	K2
c.	Discuss about the Gibbs sampling? How does it work in Markov Chain Monte Carlo?	3	K2
d.	Explain the Cauchy-Schwarz inequality in inner product spaces? Explain its significance and how it can be used to bound the inner product of two vectors. Provide an example illustrating the Cauchy-Schwarz inequality.	4	K1
e.	Define a linear transformation. Explain the conditions that a function $T:V \rightarrow W$ must satisfy to be considered a linear transformation, where V and W are vector spaces. Provide examples of linear transformations and non-linear transformations.	5	K1

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

a.	Explain probability theory and its importance in statistical analysis. Define measures of probability such as probability mass functions and probability density functions.	1	K1
b.	Discuss Chebyshev's inequality and explain how it can be used to estimate the probability that a random variable lies within a certain number of standard deviations from its mean.	1	K2

4. Attempt any *one* part of the following: **07 x 1 = 07**

a.	Discuss the difference between a t-test and a z-test. What are the assumptions underlying each test, and in what situations should each be used?	2	K2
b.	What is ANOVA (Analysis of Variance), and how does it help in comparing the means of three or more groups? Explain the concept of between-group variance and within-group variance?	2	K2

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5. Attempt any *one* part of the following: 07 x 1 = 07

a.	Discuss the inverse-transform method for generating random numbers. How does it work, and in what types of distributions is this method useful?	3	K2
b.	Describe Monte Carlo hypothesis testing. How is it used to evaluate statistical hypotheses, and what advantages does it offer over traditional hypothesis testing methods?	3	K2

6. Attempt any *one* part of the following: 07 x 1 = 07

a.	Describe the Gram-Schmidt process. Explain how this process can be used to convert a set of linearly independent vectors into an orthonormal set.	4	K2
b.	Explain inner product in a vector space? Explain the properties of an inner product, such as linearity, symmetry, and positivity.	4	K1

7. Attempt any *one* part of the following: 07 x 1 = 07

a.	Explain the concept of symmetric matrices. Discuss the properties of symmetric matrices, particularly their eigenvalues and eigenvectors.	5	K1
b.	Discuss the concept of change of basis in the context of linear transformations. Explain how a basis change affects the matrix representation of a linear transformation?	5	K2

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