JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

Computer Science & Engineering

Course Code	Deterministic & Stochastic Statistical Methods		L	T	P	C
20A54404	(Common to CSE, IT,CSE (AI), CSE (AI & ML) and AI & DS)		3	0	0	3
Pre-requisite	Basic Mathematics	Semester		IV		

Course Objectives:

This course provides a study of various Mathematical Methods and Statistical Methods which is needed for Artificial Intelligence, Machine Learning, and Data Science and also for Computer Science and engineering problems.

Course Outcomes (CO):

After completion of the course, students will be able to
- Apply logical thinking to problem-solving in context.
- Employ methods related to these concepts in a variety of data science applications.
- Use appropriate technology to aid problem-solving and data analysis.
- The Bayesian process of inference in probabilistic reasoning system.
- Demonstrate skills in unconstrained optimization.

UNIT - I	Data Representation	9 Hrs

Distance measures, Projections, Notion of hyper planes, half-planes. Principal Component Analysis- Population Principal Components, sample principal coefficients, covariance, matrix of data set, Dimensionality reduction, Singular value decomposition, Gram Schmidt process.

UNIT - II	Single Variable Distribution	9 Hrs

Random variables (discrete and continuous), probability density functions, properties, mathematical expectation-Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution.

UNIT - III	Stochastic Processes And Markov Chains:	9 Hrs

Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, step transition probabilities, Markov chain, Steady state condition, Markov analysis.

UNIT - IV	Multivariate Distribution Theory	10 Hrs

Multivariate Normal distribution – Properties, Distributions of linear combinations, independence, marginal distributions, conditional distributions, Partial and Multiple correlation coefficient. Moment generating function.
BAYESIAN INFERENCE AND ITS APPLICATIONS: Statistical tests and Bayesian model comparison, Bit, Surprisal,Entropy, Source coding theorem, Joint entropy, Conditional entropy, Kullback-Leibler divergence.

UNIT - V	Optimization	9 Hrs

Unconstrained optimization, Necessary and sufficiency conditions for optima, Gradient descent methods, Constrained optimization, KKT conditions, Introduction to non-gradient techniques, Introduction to least squares optimization, Optimization view of machine learning. Data Science Methods: Linear regression as an exemplar function approximation problem, linear classification problems.

Textbooks:
1. Mathematics for Machine Learning by A. Aldo Faisal, Cheng Soon Ong, and Marc Peter Deisenroth
2. Dr.B.S Grewal, Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
3. Operations Research, S.D. Sharma

Reference Books:
1. Operations Research, An Introduction, Hamdy A. Taha, Pearson publishers.
2. A Probabilistic Theory of Pattern Recognition by Luc Devroye,. Laszlo Gyorfi, Gabor Lugosi.

Online Learning Resources:

https://www.math.brown.edu/swatson2/classes/data1010/pdf/data1010.pdf