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&
J. T. LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program: M.Sc. Big Data Analytics

Semester II

Credit Based Semester and Grading System (CBSGS) with effect from the Academic year 2020-21

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M.Sc. Big Data Analytics Sem II Syllabus	
Objectives:	• To understand the functionality of the various data mining and data warehousing component • To pre-process and analyze the characteristics of different types of standard data, • To identify the appropriate statistical analysis technique for a business problem, • To understand fundamentals of Graph data and apply them to Relational Databases. • To recognize explicit and tacit assumptions and their consequences.
Outcomes:	• Compare different approaches of data ware housing and data mining with various technologies. • Build skills to implement different classification and clustering techniques as per requirement to extract valuable information from any type of data set. • Develop novel solutions to identify significant features in data e.g., identify the feedback of potential buyers over online markets to increase the popularity of different products. • Implement the statistical method using R and Excel. • Understanding the concept of dimensions reduction in big data • Able to identify problems, and explain, analyze, and evaluate various cloud computing solutions. • Identify, evaluate and synthesize information (obtained through library, world-wide web, and other sources as appropriate) in a collaborative environment.

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Program: M.Sc. Big Data Analytics

Course: Enabling Technologies for Data Science-I

Semester II

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M.Sc. Enabling Technologies for Data Science-I Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA201	Enabling Technologies for Data Science-I	45	3

DATA MINING:

a) **Introduction:**
Knowledge discovery from databases, scalability issues.

b) **Data Warehousing:**
General principles, modeling, design, implementation and optimization, Cloud Computing, OLAP.

c) **Data Preparation**:
Pre-processing, sub-sampling, feature selection.

d) **Classification and Prediction:**
Bayes learning, decision trees, CART, neural learning, support vector machines, associations, dependence analysis, rule generation.

e) **Cluster Analysis and Deviation Detection** Partitioning algorithms, Density bases algorithm, Grid based algorithm, Graph theoretic clustering.

f) **Temporal and spatial data mining**.

References:

1. Data Mining Techniques: A. K. Pujari, Sangam Books Ltd., 2001
2. Mastering Data Mining: M. Berry and G. Linoff, John Wiley & Sons., 2000
3. Data Mining Cookbook: Modeling Data for Marketing, Risk, and Customer Relationship Management, Olivia Parr Rud, Wiley

Evaluation: Theory: 50% + Practical/Lab: 50%

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Program: M.Sc. Big Data Analytics

Course: Machine Learning - I

Semester II

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M.Sc. Machine Learning – I Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA202	Machine Learning - I	45	3

a) **Linear Regression**
Linear Regression with Multiple variables, applications.

b) **Logistic Regression:**
Model, Classification, Problem of over-fitting, Applications.

c) **Neural Networks:**
Representation Learning, Different Models like single and multi-layer perceptron, back propagation, Application.

d) **Machine Learning System Design:**
Evaluating a learning algorithms, handling skewed data, using large data sets.

e) **Support Vector Machines:**
Model, Large Margin Classification, Kernels, SVMs in practice.

f) **Unsupervised Learning.**

g) **Dimensionality Reduction.**

h) **Anomaly Detection.**

References:

1. Machine Learning: Tom Mit chell

Evaluation: Theory: 50% + Practical/Lab: 50% (Lab: using R and/or Python)

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Program: M.Sc. Big Data Analytics

Course: Advanced Statistical Methods

Semester II

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M.Sc. Advanced Statistical Methods Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA203	**Advanced Statistical Methods**	**45**	**3**

a) **Estimation:**
Unbiasedness, Consistency, UMVUE, Maximum likelihood estimates.

b) **Test of Hypotheses**:
Two types of errors, test statistic, parametric tests for equality of means & variances.

c) **Linear Model:**
Gauss Markov Model, least square estimators, Analysis of variance.

d) **Regression**:
Multiple linear regression, forward, backward & stepwise regression, Logistic Regression.

References:

1. Statistical Inference: P. J. Bickel and K. A. Docksum, 2nd Edition, Prentice Hall.
2. Introduction to Linear Regression Analysis: Douglas C. Montgomery

Evaluation: Theory: 70% + Practical/Lab: 30% (Lab work: Using R and Python)

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Program: M.Sc. Big Data Analytics

Course: Foundations of Data Science

Semester II

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M.Sc. Foundations of Data Science Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA204	**Foundations of Data Science**	**45**	**3**

a) **Graph Theory:**
Basic Concepts, Algorithms for connectedness, shortest path, Minimum Sampling Tree, Lab: Graph Databases, Java/Python Programming

b) **High Dimensional Space:**
Properties, Law of large numbers, Sphere and cube in high dimension, Generating points on the surface of a sphere, Gaussians in High dimension, Random projection, Applications.
Lab: Graph Databases, Java/Python Programming

c) **Random Graphs:**
Large graphs, G(n,p) model, Giant Component, Connectivity, Cycles, Non-Uniform models, Applications.
Lab: Graph Databases, Java/Python Programming

d) **Singular Value Decomposition (SVD):**
Best rank k approximation, Power method for computing the SVD, Applications.
Lab: R and Python Programming (Optional: Matlab/Octave)

e) **Random Walks**:
Reflection Principle, Long leads, Changes of Sign, Illustrations.
Lab: R and Python Programming (Optional: Matlab/Octave)

f) **Algorithm for Massive Data Problems:**
Frequency Moments of data streams, matrix algorithms.
Lab: R and Python Programming (Optional: Spark, Matlab/Octave)

References:

1. Foundations of Data Science: John Hopcroft & Ravindran Kannan.

Evaluation: **Theory: 40% + Practical/Lab: 60%** (GraphDB, R, Python, Java)

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Program: M.Sc. Big Data Analytics

Course: Cloud Computing

Semester II

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M.Sc. Cloud Computing Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA205C	Cloud Computing	45	3
Introduction to Cloud computing, Cloud service methods, IaaS, PaaS, SaaS, fundamentals of cloud Architecture (load distribution, resource pooling, scalability, load balancing, redundancy, etc), Introduce DevOps, CICD. Hands-on practice either on AWS/Azure/Google Cloud Platform (Course content to be developed)			

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Program: M.Sc. Big Data Analytics

Course: Value Thinking

Semester II

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M.Sc. Value Thinking Syllabus

Semester II

Course Code	Course Title	Number of Lectures	No. of Credits
SBDA206	**Value Thinking**	**30**	**1**

This course involves watching few movies (list provided below) and reading few books (list provided below) that deals mostly with argumentative logic, evidence, drawing inference from evidences. After watching the movies and reading the books, there will be general discussion amongst the students. Couple of case studies that involve mostly logical thinking will also be presented. Each student will prepare a term paper. Evaluation will be on the basis of this term paper and participation in group discussion.

Movies:

1. Twelve Angry Men
2. Roshoman by Kurosawa
3. Trial of Nuremberg
4. Mahabharata by Peter Brook

Books:

1. The Hound of the Baskervilles by Arthur Conan Doyle
2. Five Little Pigs by Agatha Christie
3. The Purloined Letter by Edger Allan Poe
4. The Case of the Substitute Face

Evaluation: Case Studies

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Program: M.Sc. Big Data Analytics

Course: Practical-I

Semester II

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M.Sc. Practical-I Syllabus

Semester II

Course Code	Course Title	Number of Practical Session	No. of Credits
SBDA201PR	Practical-I based on SBDA201(Enabling Technologies for Data Science-I), SBDA202(Machine Learning - I)	**40**	**4**

a) Data Warehousing:
General principles, modeling, design, implementation and optimization, Cloud Computing, OLAP.
b) Data Preparation:
Pre-processing, sub-sampling, feature selection.
c) Classification and Prediction:
Bayes learning, decision trees, CART, neural learning, support vector machines, associations, dependence analysis, rule generation.
d) Cluster Analysis and Deviation Detection:
Partitioning algorithms, Density bases algorithm, Grid based algorithm, Graph theoretic clustering.
e) Temporal and spatial data mining.

f) Linear Regression
Linear Regression with Multiple variables, applications.
g) Logistic Regression:
Model, Classification, Problem of over-fitting, Applications.
h) Neural Networks:
Representation Learning, Different Models like single and multi-layer perceptron, back propagation, Application.
i) Machine Learning System Design:
Evaluating a learning algorithm, handling skewed data, using large data sets.
j) Support Vector Machines:
Model, Large Margin Classification, Kernels, SVMs in practice.

k) Unsupervised Learning.
l) Dimensionality Reduction.
m) Anomaly Detection.

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Program: M.Sc. Big Data Analytics

Course: Practical-II

Semester II

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M.Sc. Practical-II Syllabus

Semester II

Course Code	Course Title	Number of Practical Session	No. of Credits
SBDA202PR	Practical-II based on SBDA203(Advanced Statistical Methods), SBDA204(Foundations of Data Science)	**40**	**4**

a) Graph Theory :
Basic Concepts, Algorithms for connectedness, Shortest path, Minimum Sampling Tree,
Lab: Graph Databases, Java/Python Programming
b) High Dimensional Space:
Properties, Law of large numbers, Sphere and cube in high dimension, Generating points on the surface of a sphere, Gaussians in High dimension, Random projection, Applications.
Lab: Graph Databases, Java/Python Programming
c) Random Graphs :
Large graphs, G(n,p) model, Giant Component, Connectivity, Cycles, Non-Uniform models, Applications.
Lab: Graph Databases, Java/Python Programming
d) Singular Value Decomposition (SVD):
Best rank k approximation, Power method for computing the SVD, Applications.
Lab: R and Python Programming (Optional: Matlab/Octave)
e) Random Walks:
Reflection Principle, Long leads, Changes of Sign, Illustrations.
Lab: R and Python Programming

f) Algorithm for Massive Data Problems:
Frequency Moments of data streams, matrix algorithms.
Lab: R and Python Programming
g) Estimation:
Unbiasedness, Consistency, UMVUE, Maximum likelihood estimates.
h) Test of Hypotheses:
Two types of errors, test statistic, parametric tests for equality of means & variances.
i) Linear Model:
Gauss Markov Model, least square estimators, Analysis of variance.
j) Regression:
Multiple linear regression, forward, backward & stepwise regression, Logistic Regression.

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Program: M.Sc. Big Data Analytics

Course: Practical-III

Semester II

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M.Sc. Practical-III Syllabus

Semester II

Course Code	Course Title	Number of Practical Session	No. of Credits
SBDA203PR	Practical-III based on SBDA205C (Cloud Computing)	**20**	**2**
Hands-on practice either on AWS/Azure/Google Cloud Platform			

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