List of Open Electives offered by Emerging departments

Applicable for 2019-20 Batch (R19) from the A. Y. 2022-23 onwards

Name of the department offering open elective	Open Elective-I (Third Year - Semester 1I)	Open Elective-II (Fourth Year- Semester I)	Open Elective-III (Fourth Year- Semester II)
Computer Science and Engineering (AI&ML)	19AM3261-Modern Artificial Intelligence	19AM4163-Introduction to NLP	19AM4265-Computer Vision
	19AM3262-Machine Learning Basics	19AM4164-Deep Learning	19AM4266-Soft Computing
Computer Science and Engineering (Data Science)	19DS3261- Fundamentals of Data Science	19DS4163-Data Mining Techniques	19DS4265-Introduction to Social Media Mining
	19DS3262-R Programming	19DS4164-Data Analytics	19DS4266-Data Visualization Using Python
Computer Science and Engineering (Cyber Security)	19CY3261 Cyber Laws	19CY4163 Computer Security & Audit Assurance	19CY4265 Data Privacy
	19CY3262 Ethical Hacking	19CY4164 Social Media Security	19CY4266 5G Technologies
Computer Science and Business System (CSBS)	19BU3261 - Operation Research - II	19BU4163 - R-Programming	19BU4265 - Innovation IP Management &Entrepreneurship
	19BU3262 - Cloud Computing	19BU4164 - Design Thinking	19BU4266 - Social Media Analytics

*Note: Students should take Open Electives from the List of Open Electives Offered by
Other Departments/Branches Only.*

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING(AI&ML)

19AM3261: MODERN ARTIFICIAL INTELLIGENCE
(Open Elective - I)

B.Tech.III Year IISem.

	L	T	P	C
	3	0	0	3

Course Objectives:

1. Understand the importance of AI based systems.
2. Use AI based techniques in real world problems.
3. Design an intelligent system, component or process to meet desired needs with constraints.
4. Create artificial intelligence systems for multidisciplinary domains.
5. Work collaborates to formulate and solve engineering problems based on AI principles.

Course Outcomes:

1. Understand the principles and approaches of artificial intelligence and different aspects of Intelligent agent.
2. Apply different search techniques for solving real world complex problems and select the most appropriate solution by comparative evaluation.
3. Design AI based systems and their components with reasoning even in the presence of incomplete and/or uncertain information.
4. Develop knowledge-based systems with proper representation schemes.
5. Analyze the pros and cons of different AI systems and their design.

UNIT-I
Introduction: Overview of Artificial Intelligence- Problems of AI, AI Technique, Tic - Tac - Toe Problem. **Intelligent Agents:** Agents & Environment, Nature Of Environment, Structure Of Agents, Goal Based Agents, Utility Based Agents, Learning Agents.

Problem Solving: Problems, Problem Space & Search: Defining The Problem As State Space Search, Production System, Problem Characteristics, Issues In The Design Of Search Programs.

UNIT II

Search Techniques: Solving Problems by Searching, Problem Solving Agents, Searching For Solutions; **Uniform Search Strategies:** Breadth First Search, Depth First Search, Depth Limited Search, Bi-directional Search, Comparing Uniform Search Strategies.

Heuristic Search Strategies: Greedy Best-First Search, A* Search, Memory Bounded Heuristic Search: Local Search Algorithms & Optimization Problems: Hill Climbing Search, Simulated Annealing Search, Local Beam Search, Genetic Algorithms; Constraint Satisfaction Problems, Local Search For Constraint Satisfaction Problems.

Adversarial Search: Games, Optimal Decisions & Strategies in Games, The Mini Max Search Procedure, Alpha-Beta Pruning, Additional Refinements, Iterative Deepening.

UNIT III

Knowledge & Reasoning: Knowledge Representation Issues, Representation & Mapping, Approaches to Knowledge Representation, Issues in Knowledge Representation.

Using Predicate Logic: Representing Simple Fact in Logic, Representing Instant & ISA Relationship, Computable Functions & Predicates, Resolution, and Natural Deduction.

Representing Knowledge Using Rules: Procedural Verses Declarative Knowledge, Logic Programming, Forward Verses Backward Reasoning, Matching, Control Knowledge

UNIT IV

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Bayesian Networks, Dempster-Shafer Theory.

Planning: Overview, Components of A Planning System, Goal Stack Planning, Hierarchical Planning. **Learning:** Forms of Learning, Inductive Learning, Explanation Based Learning, Neural Net Learning & Genetic Learning.

UNIT V

Natural Language Processing: Brief introduction to Syntactic Processing, Semantic Analysis, Discourse & Pragmatic Processing.

Robotics: Introduction, Robot hardware, robotic perception, planning to move, planning uncertain movements, robotic software architecture, application domains.

Text books:

1. Russel S. and Norvig P. "Artificial Intelligence a Modern Approach", 3rd Edition, Pearson Education.

2. Rich E. & Knight K. "Artificial Intelligence", 2nd Edition, TMH, New Delhi

19AM3262: MACHINE LEARNING BASICS
(Open Elective - I)

B.Tech.III Year IISem.	L	T	P	C
	3	0	0	3

Course Objectives:

1. To formulate machine learning problems corresponding to different applications.
2. To understand various supervised, semi-supervised and unsupervised machine learning algorithms.
3. To familiarize various machine learning software libraries and data sets publicly available.
4. To develop machine learning based system for various real-world problems.
5. To assess how the choice of a machine learning algorithm impacts the accuracy of a system.

Course Outcomes:
1. Formulate machine learning problems corresponding to different applications: data, model selection, model complexity
2. Demonstrate understanding of a range of machine learning algorithms along with their strengths and weaknesses
3. Implement machine learning solutions to classification, regression, and clustering problems
4. Design and implement various machine learning algorithms in a range of real-world applications
5. Evaluate and analyse the performance of a machine learning algorithm or a system based on machine learning algorithm

UNIT I
Introduction to Machine Learning Machine Learning – what and why? Supervised learning and unsupervised learning. Basics of Linear Algebra - matrices and vectors, Eigen value decomposition, principal component analysis.

UNIT II
Supervised Learning Linear Regression with one variable, cost function, gradient descent for linear regression. Linear regression with multiple variables, normal equation, gradient descent. Logistic regression, cost function, gradient descent. Regularization - the problem of overfitting, regularization in linear regression and logistic regression.

UNIT III

Dimensionality reduction- Principal components. Decision Tree, Overfitting and Pruning, Support Vector Machine and Kernel; Noise, bias-variance trade-off, under-fitting and overfitting concepts.

UNIT IV
Neural Networks representations, forward propagation, multi class classification. neural networks cost function, backpropagation algorithm. Regularization and bias/ variance. Recurrent networks.

UNIT V
Unsupervised and Semi Supervised Learning Clustering - K-means partitional clustering, choosing the number of clusters. Hierarchical Agglomerative Clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabeled data. Brief introduction to ML applications in computer vision, speech and natural language processing, etc.

Text Books:

1. Mitchell Tom, "Machine Learning", Latest Edition, Mc-Graw Hill.

Reference Books:
1. Shwartz Shai Shalev, and David Shai Ben, "Understanding Machine Learning", Cambridge University Press, 2017.

2. Bishop Christopher "Pattern Recognition and Machine Learning", Springer, 2006.

3. A Course in Machine Learning by Hal Daumé III

19AM4163: INTRODUCTION TO NLP
(Open Elective - II)

B.Tech.IV Year ISem.	L	T	P	C
	3	0	0	3

CourseObjectives:

1. Tounderstandthealgorithmsavailablefortheprocessingoflinguisticinformationand computational propertiesofnatural languages.
2. Toconceivebasicknowledgeonvariousmorphological,syntacticandsemanticNLPtasks.
3. TofamiliarizevariousNLPsoftwarelibrariesanddatasetspubliclyavailable.
4. TodevelopsystemsforvariousNLPproblemswithmoderatecomplexity.
5. TolearnvariousstrategiesforNLPsystemevaluationanderroranalysis.

CourseOutcomes:
1. Describe the typical NLP problems, their importance & difficulty; and conceptsofmorphology,syntax,semantics,discourse &pragmaticsofnaturallanguage.
2. Demonstrate understanding of the relationship between NLP and statistics &machinelearning.
3. Discovervariouslinguisticandstatisticalfeatures relevanttothebasicNLPtask,namely, spelling correction, morphological analysis, parts-of-speech tagging,parsingand semanticanalysis.
4. DevelopsystemsforvariousNLPproblemswithmoderatecomplexity.
5. Evaluate a NLP system, identify shortcomings and suggest solutions for these short comings.

UNIT 1

NLP– introduction andapplications, NLPphases, Difficulty of NLPincluding ambiguity;Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar ofEnglish.

UNIT II

N-gramandNeuralLanguageModels: LanguageModellingwithN-gram,SimpleN-grammodels,Smoothing(basictechniques),Evaluating language models; Neural Network basics, Training; Neural Language Model, Casestudy:application ofneurallanguagemodel in NLPsystem development.

UNIT III

Parts-of-speechTagging: Basicconcepts;Tagset;
Earlyapproaches:RulebasedandTBL;POStaggingusingHMM, POS
TaggingusingMaximum EntropyModel.**(8L)**

UNIT IV

**Parsing-
Basicconcepts:**topdownandbottomupparsing,treebank;Syntacticparsing:C
KYparsing;**Statistical Parsing Basics:** Probabilistic Context Free
Grammar (PCFG); Probabilistic CKYParsingof PCFGs.

UNIT V

Semantics:
VectorSemantics;WordsandVector;MeasuringSimilarity;Semanticswithdens
evectors;SVDandLatentSemanticAnalysis;

Embeddingsfromprediction: Skip-gramandCBOW;Conceptof Word Sense;
Introduction to WordNet.

Textbooks:

1.JurafskyDanandMartinJamesH.“SpeechandLanguageProcessing”,3rd
Edition, 2018.

Referencebooks:

1. Jurafsky D.and Martin J. H., “Speech and language processing: An
Introduction toNatural Language Processing, Computational Linguistics,
and Speech Recognition”,2ndEdition,Upper Saddle River, NJ: Prentice-Hall,
2008.
2.GoldbergYoav“APrimeronNeuralNetworkModelsforNatural
LanguageProcessing”.

19AM4164: DEEP LEARNING
(Open Elective - II)

B.Tech.IV Year I Sem.	L	T	P	C
	3	0	0	3

Course Objectives:

1. To understand the basic component of Machine Learning.
2. To explore the application areas of Neural Networks.
3. To understand the idea of Recurrent Neural Networks.
4. To explore the basic concepts of Feed forward Neural Networks.
5. To understand the concepts of mathematical modelling.

Course Outcomes:

1. Able to differentiate between machine learning and deep learning
2. Identify problems suitable for application of deep learning.
3. Illustrate the working of FF Neural Networks and their modifications.
4. Apply Convolutional & Recurrent Neural Networks to solve problems
5. Analyse the efficiency of deep learning systems.

UNIT I

Introduction and Basics of Machine Learning Beginnings of ANN, XOR Problem, From Cognitive Science to Deep Learning, NNs and their importance. Elementary classification problem, evaluating classification results, Simple Classifier – Naïve Bayesian Classifier, Simple NN: Logistic Regression, Learning without Labels, Learning alternative representation of data – PCA.

UNIT II

Feed forward Neural Networks: Basic concept and terminology, Representing networks, Perceptron rule, Delta rule, From logistic regression to Backpropagation, Backpropagation, Complete Feedforward NNs.

UNIT III

Modifications & Extensions of FF Neural Nets Regularization, L1 & L2 regularization, Learning Rate, Momentum and Dropout, Stochastic Gradient

Descent and Online Learning, Problems with multiple hidden layers, Vanishing and exploding gradients.

UNIT IV

Convolution & Recurrent Neural Networks Introduction, Feature maps and Pooling, Building a complete convolutional neural network. Recurrent Neural Networks – Sequences of unequal length, Settings for learning with recurrent neural networks, Adding feedback loops and Unfolding neural networks, Elman Networks, LSTM

UNIT V

Auto encoders Learning Representations, Different Autoencoder Architectures, Stacking Autoencoders.

Text Book:

1. Skansi S., Introduction to Deep Learning - From Logical Calculus to Artificial Intelligence, 1st Edition, Springer International Publishing, 2018.

Reference Book:

1. Buduma N., Fundamentals of Deep Learning, 1st Edition, O Reilly Media, 2016.

19AM4265: COMPUTER VISION
(Open Elective - III)

B.Tech.IV Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives:

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks

Course Outcomes:

- Developed the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images.
- Develop algorithm for classification and clustering.
- Illustrate the techniques of feature extraction and analysis.
- Apply in different engineering application such activity recognition, computational photography, biometrics.

UNIT I

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

UNIT II

Edge detection, Edge detection performance, Hough transform, corner detection.

UNIT III Segmentation, Morphological filtering, Fourier transforms Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools,

Feature analysis, feature vectors, distance /similarity measures, data preprocessing.

UNIT IV

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminate Function, Supervised, Un-supervised, Semi supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA,ICA, and Non-parametric methods.

UNIT V

Recent trends in Activity Recognition, computational photography, Biometrics.

Text Books:

1. Szeliski,R.," Computer Vision: Algorithms and Applications,"Springer,2011.
2. Good fellow, Bengio, and Courville,"Deep Learning," First Edison.MIT Press,2016.
3. Fisher,R.B.,Breckon,T. P. , Dawson-Howe,K,Fitzgibbon,A , Robertson,C., Trucco,E. , Williams,C. K. I., "Dictionary of Computer Vision and Image Processing,"Second Edison,Wiley,2014.

Reference Book:

1. Forsyth,D.A.,Ponce,J.,"Computer Vision A Modern Approach," Second Edison, Pearson Education,2015.

19AM4266: SOFT COMPUTING
(Open Elective - III)

B.Tech.IV Year II Sem.

	L	T	P	C
	3	0	0	3

Course objectives:

1. To make the student to understand the role of imprecision and uncertainty in real world scenarios.

2. To explain the role of Soft Computing in addressing the imprecision and uncertainty.

3. To explain the principal components of soft computing that include Fuzzy Sets and Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms and Rough Sets.

4. To learn the Design and Implementation of Soft Computing methodologies.

5. To explain the design of hybrid systems which is combination of one or more soft computing methodologies mentioned.

Course outcomes:

1. Ability to represent Uncertainty / imprecision data.

2. Ability to select a suitable method of Soft Computing to solve a particular problem.

3. Ability to build hybrid systems using Soft Computing techniques.

UNIT I

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network - Adaline Network - Madaline Network.

UNIT II

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network-Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification -

Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNITIV

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT- V

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TEXT BOOKS:

1. S.N.Sivanandam ,S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
2. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCES
1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, ―Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. Kwang H.Lee, ―First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.

19DS3261   FUNDAMENTALS OF DATA SCIENCE
(Open Elective–I)

B.Tech.III Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives

1. To learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration
2. To exploring data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication
3. To understand the basic knowledge of algorithms and reasonable programming experience and some familiarity with basic linear algebra and basic probability and statistics
4. To understand the basic knowledge on feature selection algorithms.
5. To identify the importance of recommendation systems and data visualization techniques

Course Outcomes

1. Understand basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data
2. Discuss the significance of exploratory data analysis (EDA) in data science and to apply basic tools (plots, graphs, summary statistics) to carry out EDA
3. Apply basic machine learning algorithms and to identify common approaches used for Feature Generation
4. Analyze fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine and to Build their own recommendation system using existing components
5. Create visualization of a complex datasets.

UNIT I:

Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R.

UNIT II:
Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The

Data Science Process - Case Study: Real Direct (online real estate firm) - Three Basic Machine Learning Algorithms, Linear Regression - k-Nearest Neighbors (k-NN) - k-means.

UNIT III:
One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam

UNIT IV:
Data Wrangling: APIs and other tools for scrapping the Web - Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests

UNIT V:
Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset - **Data Science and Ethical Issues** - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists

TEXT BOOKS:

1. Doing Data Science, Straight Talk From The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly, 2014

2. Mining of Massive Datasets v2.1, Jure Leskovek, AnandRajaraman and Jeffrey Ullman, Cambridge University Press, 2014

3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2013 (ISBN 0262018020)

REFERENCE BOOKS:

1. Elements of Statistical Learning, Trevor Hastie, Robert TiBUhirani and Jerome Friedman, 2nd Edition, 2009 (ISBN 0387952845)

2. Foundations of Data Science, Avrim Blum, John Hopcroft and Ravindran Kannan

3. Data Mining and Analysis: Fundamental Concepts and Algorithms, Mohammed J. Zaki and Wagner Miera Jr. Cambridge University Press, 2014

4. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, 3rd Edition, 2011 (ISBN 0123814790)

19DS3262   R PROGRAMMING
(OpenElective–I)

B.Tech.III Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives:
1. Understanding and being able to use basic programming concepts
2. Automate data analysis
3. Working collaboratively and openly on code
4. Knowing how to generate dynamic documents
5. Being able to use a continuous test-driven development approach

Course Outcomes:
1. Understand to use and program in the programming language R
2. Understand to use R to solve statistical problems
3. Implement and describe Monte Carlo the technology
4. Implement minimize and maximize functions using R
5. Analysizing customized graphs and creating three-dimensional plots.

UNIT – I
Introduction: Overview of R, R data types and objects, reading and writing data, sub setting, R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations.

UNIT – II
Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes, Vectors: Generating sequences, Vectors and suBUcripts, Extracting elements of a vector using suBUcripts, Working with logical suBUcripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations.

UNIT – III
Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List, Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List, Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations.

UNIT - IV

Factors and Tables: Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions.

UNIT - V

Graphics: Creating Graphs, Customizing Graphs, Saving Graphs to Files, Customizing Graphs, Creating Three-Dimensional Plots.
Debugging: Fundamental Principles of Debugging, Why Use a Debugging Tool?, Using R Debugging Facilities, Moving Up in the World: More Convenient Debugging Tools, Ensuring Consistency in Debugging Simulation Code, Syntax and Runtime Errors, Running GDB on R Itself.

TEXT BOOKS:
1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Norman Matloff Cengage Learning India.

REFERENCE BOOKS:
1. Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition, O'Reilly.
2. Tilman M. Davies, The book of R a first course in programming and statistics, no starch press.

B.Tech.IV Year I Sem.	L	T	P	C
	3	0	0	3

Pre-Requisites:
1. Acourseon"DatabaseManagementSystems"
2. Knowledgeofprobabilityandstatistics

CourseObjectives:
1. Examine the types of the data to be mined and apply pre-processing methods on raw data.
2. To introduce the basic concepts of Data Warehouse and Data Mining techniques .
3. Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data.
4. Prepare students for research in the area of data mining and related applications and Enhance students communication and problem solving skills.
5. Provide the students with practice on applying data mining solutions using common data mining software tool /programming languages.

CourseOutcomes:
1. Describe the fundamentals of data mining systems as well as issues related to access and retrieval of data at scale.
2. Explain the various data mining functionalities and data warehousing techniques.
3. Apply the various data mining techniques to solve classification, clustering and association rule mining problems.
4. Analyze and choose among different approaches of a data mining task.
5. Design and evaluate data mining models to be used in solving real life problems, keeping in view social impacts of data mining

UNIT-I
Data Mining: Introduction, Relational Databases, Data Warehouses, Transactional databases, Advanced database Systems and Application, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining. **Data Processing:** Data Cleaning, Data

Integration and Transformation, Data Reduction..

UNIT-II
Data Warehouse: Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data Warehousing to Data Mining. Data Cube Computation and Data Generalization.

UNIT-III
Mining Association Rules in Large Databases: Association Rule Mining, Single – Dimensional Boolean Association Rules, Multilevel Association Rules from Transaction Databases, Multi Dimensional Association Rules from Relational Databases, From Association Mining to Correlation Analysis.

UNIT - IV
Classification and Prediction: Classification & Prediction, Issues Regarding   Classification & Prediction, Classification by decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification based on concepts & Association Rule Analysis, Other Classification Methods, Prediction, Classification Accuracy.

UNIT-V
Cluster Analysis: Introduction, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Method - k-Medoids Algorithm, CLARANS, Hierarchical Methods - BIRCH, ROCK Density-Based Methods - DBSCAN, Outlier Analysis.

TEXTBOOKS:
1. Jiawei Han & Micheline Kamber "Data Mining Concepts & Techniques", Publisher Harcourt India. Private Limited, 3 nd Edition.

REFERENCEBOOK:
1. Gupta G.K. "Introduction to Data Mining with case Studies", PHI, New Delhi, 2006.
2. Berson A. & Smith S.J. "Data Warehousing Data Mining", COLAP, TMH, New Delhi, 2004.
3. Dunham H.M. & Sridhar S. "Data Mining", Pearson Education, New Delhi, 2006.

19DS4164   DATA ANALYTICS
(Open Elective– II)

B.Tech.IV Year I Sem.

	L	T	P	C
	3	0	0	3

Prerequisites
1. Data Base Management Systems, Computer Oriented Statistical Methods

Course Objectives
1. To explore the fundamental concepts of data analytics.
2. To learn the principles and methods of statistical analysis
3. To develop problem solving abilities using Mathematics
4. To learn classification and regression concepts.
5. To apply algorithmic strategies while solving problems

Course Outcomes
1. Identify the various sources of Big Data.
2. Apply several key big data technologies used for storage, analysis and manipulation of data.
3. Design methodologies to extract data from structured and un-structured data for analytics
4. Apply Regression algorithms to perform data analytics.
5. Apply advanced regression and Time series modeling to Discover interesting patterns

UNIT - 1
Data Management: Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data pre-processing , Missing Values - Outlier Detection and Treatment.

UNIT- 2
Introduction to Tools and Environment, Application of Modelling in Business, Databases & Types of data and variables, Data Modelling Techniques, Missing imputations etc. Need for Business Modeling.

UNIT - 3
Regression – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc. Logistic

Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT - 4
Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Over fitting, Pruning and Complexity, Multiple Decision Trees etc.
Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction.

UNIT - 5
Working with Documents:
Standard Operating Procedures for documentation and knowledge sharing. Defining purpose and scope documents, Understanding structure of documents — case studies, articles, white papers, technical reports etc., Intellectual Property and Copyright, Document preparation tools.

TEXT BOOKS:
1. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.
2. Associate Analytics Handbook.

REFERENCES:
1. Mining of Massive Datasets, Jure Leskovec Stanford Univ. AnandRajaramanMilliway Labs Jeffrey D Ullman Stanford Univ.
2. Michael Minelli, Michele Chambers, AmbigaDhiraj ,"Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
3. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley & Sons, 2014

19DS4265   INTRODUCTION TO SOCIAL MEDIA MINING
(Open Elective– III)

B.Tech.IV Year II Sem.	L	T	P	C
	3	0	0	3

CourseObjectives:

1. To provide **e**xposuretovariouswebandsocialmediaanalytictechniques.
2. To introduce the concepts of business intelligence analytics.
3. To provide exposure on text mining and text mining applications.
4. Introduce concepts like sentiment analysis and speech analytics.
5. To provide exposure on social media analytics.

CourseOutcomes:

1. Knowledgeondecisionsupport systems.
2. Applynaturallanguageprocessingconceptsontextanalytics.
3. Understandsentimentanalysis.
4. Knowledgeonsearchengineoptimizationandwebanalytics.
5. Understand social network analysis concepts.

UNIT-I
An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage aVaccine Supply Chain Effectively and Safely, Changing Business Environments and ComputerizedDecisionSupport,InformationSystemsSupportforDecisionMaking,TheConceptofDecisionSupportSystems(DSS),BusinessAnalyticsOverview,BriefIntroductiontoBigData Analytics.

UNIT-II
Text Analytics and Text Mining: Machine Versus Men on Jeopardy!: The Story of Watson, TextAnalytics and Text Mining Concepts and Definitions,NaturalLanguage Processing,Text MiningApplications,TextMiningProcess,TextMining Tools.

UNIT-III

SentimentAnalysis: SentimentAnalysisOverview,SentimentAnalysisApplications,SentimentAnalysisProcess,SentimentAnalysisand Speech Analytics.

UNIT-IV
Web Analytics, Web Mining: Security First Insurance Deepens Connection with Policyholders, WebMiningOverview,WebContentandWebStructureMining,SearchEngines,SearchEngineOptimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web AnalyticsTools.

UNIT-V
SocialAnalyticsandSocialNetworkAnalysis: SocialAnalyticsandSocialNetworkAnalysis,SocialMediaDefinitionsand Concepts,SocialMediaAnalytics.

TEXTBOOK:
1.RameshSharda,DursunDelen,EfraimTurban,BUSINESSINTELLIGENCEANDANALYTICS:SYSTEMSFOR DECISION SUPPORT,PearsonEducation.

REFERENCEBOOKS:
1. RajivSabherwal,IrmaBecerra-Fernandez,"BusinessIntelligence–Practice,TechnologiesandManagement",JohnWiley2011.
2. LarissT.Moss,ShakuAtre,"BusinessIntelligenceRoadmap",Addison-WesleyItService.
3. YuliVasiliev,"OracleBusinessIntelligence:TheCondensedGuideto AnalysisandReporting",SPDShroff,2012.

19DS4266   DATA VISUALIZATION USING PYTHON
(Open Elective– III)

B.Tech.IV Year II Sem.	L	T	P	C
	3	0	0	3

CourseObjective:

1. Tounderstandvariousdatavisualizationtechniques.
2. To provide exposure on geospatial and multivariate data.
3. To understand various levels of text representations.
4. To introduce various interaction concepts and techniques.
5. To discuss on issues of Data, cognition and issues ofSystem Design Evaluation

CourseOutcomes:

1. Visualizethe objectsindifferentdimensions.
2. Designandprocessthe dataforVirtualization.
3. Applythevisualizationtechniquesinphysicalsciences,computerscience,appliedmathematicsandmedical science.
4. Applythevirtualization techniquesfor research projects.
5. Understand issues ofSystem Design Evaluation

UNIT-I
Introduction and Data Foundation: Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types ofData-Structurewithin and betweenRecords-Data Preprocessing -Data Sets

UNIT-II
Foundations for Visualization: Visualization stages - Semiology of Graphical Symbols - The EightVisual Variables - Historical Perspective - Taxonomies - Experimental Semiotics based on PerceptionGibson'sAffordancetheory– AModel ofPerceptual Processing.

UNIT-III

Visualization Techniques: Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three-DimensionalData-DynamicData-CombiningTechniques.

GeospatialData: VisualizingSpatialData- Visualization of Point Data - Visualization of Line Data - Visualization of Area Data - Other Issues inGeospatial Data Visualization

Multivariate Data: Point-Based Techniques - Line- Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures –Graphicsand Networks-DisplayingArbitraryGraphs/Networks.

UNIT-IV
Interaction Concepts and Techniques: Text and Document Visualization: Introduction - Levels ofTextRepresentations-TheVectorSpaceModel-SingleDocumentVisualizations-DocumentCollectionVisualizations-ExtendedTextVisualizations

InteractionConcepts:InteractionOperators-Interaction Operands and Spaces - A Unified Framework.

Interaction Techniques: Screen Space -Object-Space-DataSpace-AttributeSpace-DataStructureSpace-VisualizationStructure-AnimatingTransformations-Interaction Control

UNIT-V
Research Directions in Virtualizations: Steps in designing Visualizations – Problems in designingeffective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues ofSystem Design Evaluation,Hardware andApplications.

TEXTBOOKS:
1.   MatthewWard,GeorgesGrinsteinandDanielKeim,"InteractiveDataVisualizationFoundations,Techniques,Applications",2010.
2.   ColinWare,"InformationVisualizationPerception forDesign",2ndedition,MargonKaufmannPublishers,2004.

REFERENCEBOOKS:
1.   RobertSpence"Informationvisualization–Designforinteraction",PearsonEducation,2ndEdition,2007.
2.   AlexandruC.Telea,"DataVisualization:PrinciplesandPractice,"A.K.PetersLtd,2008.

19CY3261: CYBER LAWS (Open Elective – I)

B.Tech.III Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives: To understand the significance of cyber laws and different acts.

Course Outcomes:

1. Understand the need of cyber laws.
2. Understand the important provisions of the act and significance of digital signatures.
3. Analyze regulatory authorities in cyber law.
4. Overview of cybercrime and procedure to report cybercrime.

UNIT - I

Introduction: History of Internet and World Wide Web, need for cyber law, Cybercrime on the rise, Important terms related to cyber law.

Cyber law in India: Need for cyber law in India, History of cyber law in India, Information Technology Act, 2000, Overview of other laws amended by the IT Act, 2000, National Policy on Information Technology 2012.

UNIT - II

Overview of The Information Technology Act, 2000: Applicability of the Act, Important provisions of the Act: Digital signature and Electronic signature, Digital Signature under the IT Act, 2000, EGovernance Attribution, Acknowledgement and Dispatch of Electronic Records, Certifying Authorities, Electronic Signature Certificates, Duties of Subscribers, Penalties and Offences, Intermediaries.

UNIT - III

Overview of Rules Issued Under the IT Act, 2000, Electronic Commerce, Electronic Contracts, Cyber Crimes, Cyber Frauds.

UNIT - IV

Regulatory Authorities: Department of Electronics and Information Technology, Controller of Certifying Authorities (CCA), Cyber Appellate Tribuna, Indian Computer Emergency Response Team (ICERT), Cloud Computing, Case Laws.

UNIT - V

Introduction to Cybercrime and Procedure to Report Cybercrime: Procedure to Report Cyber Crime, Some Basic Rules For Safe Operations of the Computer and Internet, The Criminal Law (Amendment) Act, 2013: Legislative Remedies For Online Harassment And Cyberstalking In India.

TEXT BOOKS:

1. Pavan Duggal, Textbook On Cyber Law, second edition, Universal Law.
2. Pavan Duggal, Indian CyberlawOn Cyber Crimes.

REFERENCE BOOKS:

1. Debby Russell and Sr. G.T. Gangemi, "Computer Security Basics (Paperback)", 2nd Edition, O' Reilly Media, 2006.
2. Thomas R. Peltier, "Information Security policies and procedures: A Practitioner's Reference", 2nd Edition Prentice Hall, 2004.
3. Kenneth J. Knapp, "Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions", IGI Global, 2009.
4. Thomas R Peltier, Justin Peltier and John blackley, "Information Security Fundamentals", 2nd Edition, Prentice Hall, 1996.
5. Jonathan Rosenoer, "Cyber law: the Law of the Internet", Springer-verlag, 1997. James Graham, "Cyber Security Essentials" Averbach Publication T & F Group.

19CY3262: ETHICAL HACKING (Open Elective – I)

B.Tech.III Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives:

- The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security.
- The course includes -Impacts of Hacking; Types of Hackers; Information Security Models; Information Security Program; Business Perspective; Planning a Controlled Attack; Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration)

Course Outcomes:

- Gain the knowledge of the use and availability of tools to support an ethical hack
- Gain the knowledge of interpreting the results of a controlled attack
- Understand the role of politics, inherent and imposed limitations and metrics for planning of a test
- Comprehend the dangers associated with penetration testing

UNIT- I

Introduction: Hacking Impacts, The Hacker

Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration.

Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture

Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking.

UNIT - II

The Business Perspective: Business Objectives, Security Policy, Previous Test Results, Business Challenges.

Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement.

UNIT - III

Preparing for a Hack: Technical Preparation, Managing the Engagement.

Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance.

UNIT - IV

Enumeration: Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase.

Exploitation: Intutive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern.

UNIT - V

Deliverable: The Deliverable, The Document, Overall Structure, Aligning Findings, Presentation.

Integration: Integrating the Results, Integration Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion.

TEXT BOOK:

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", Auerbach Publications, CRC Press.

REFERENCE BOOKS:

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning.
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network, Defense", Cengage Learning.

19CY4163: COMPUTER SECURITY & AUDIT ASSURANCE
(Open Elective - II)

B.Tech.IV Year I Sem.	L	T	P	C
	3	0	0	3

Course Objectives:

1. State the basic concepts in information systems security, including security technology and principles, software security and trusted systems, and IT security management.
2. Explain concepts related to various cryptographic tools.

Course Outcomes:

1. State the requirements and mechanisms for identification and authentication.
2. Explain and compare the various access control policies and models as well as the assurance of these models.
3. Understand various standard practices and policies in conducting audits.
4. Understand and analyze the significance of Network Security and Control, Internet Banking Risks and Control.

UNIT - I

System Audit and Assurance – Characteristics of Assurance services, Types of Assurances services, Certified Information system auditor, Benefits of Audits for Organization, COBIT.

UNIT - II

Internal Control and Information system Audit - Internal Control, Detective control, Corrective Control, Computer Assisted Audit Tools and Techniques.

UNIT - III

Conducting Audit – Standard practices, policies, Audit planning, Risk Assessment, Information gathering techniques, Vulnerabilities, System security testing, conducting Audits for Banks.

UNIT - IV

Network Security and Control, Internet Banking Risks and Control, Operating System Risks and Control, Operational Control Overview.

UNIT - V

Business Continuity and Disaster Recovery Planning Control – Data backup/storage, developing appropriate Disaster recovering strategy, Business Impact analysis.

TEXT BOOK:

1. Information System Audit and Assurance; D. P. Dube, Ved Prakash Gulati; Tata McGraw- Hill Education, 01 Jan 2005.

REFERENCE BOOKS:

1. William Stallings and Lawrie Brown, Computer Security: Principles and Practice, Pearson education
2. Martin Weiss and Michael G. Solomon, Auditing IT Infrastructures For Compliance (Information Systems Security & Assurance), Jones and Bartlett Publishers, Inc.

19CY4164: SOCIAL MEDIA SECURITY
(Open Elective – II)

B.Tech.IV Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Give introduction about the social networks, its use, the need of security in social data.

Course Outcomes:

1. Learn about browser's risks.
2. Learn about Social Networking, Understand the risks while using social media. Guidelines for social networking.
3. Understand how to secure different web browsers.
4. Understand how an e-mail works, learn threats involved using an email communication, safety measures while using e-mail.

UNIT – I

Introduction to Social Media, Understanding Social Media, Different Types and Classifications, The Value of Social Media, Cutting Edge Versus Bleeding Edge, The Problems That Come With Social Media, Is Security Really an Issue? Taking the Good With the Bad.

UNIT - II
Dark side Cybercrime, Social Engineering, Hacked accounts, cyberstalking, cyberbullying, predators, phishing, hackers.

UNIT – III
Being bold versus being overlooked Good social media campaigns, Bad social media campaigns, Sometimes it's better to be overlooked, Social media hoaxes, The human factor, Content management, Promotion of social media.

UNIT - IV
Risks of Social media Introduction Public embarrassment, Once it's out there, it's out there False information, Information leakage, Retention and archiving, Loss of data and equipment.

UNIT – V

Policies and Privacy Blocking users controlling app privacy, Location awareness, Security Fake accounts passwords, privacy and information sharing.

TEXT BOOKS:

1. Interdisciplinary Impact Analysis of Privacy in Social Networks, Recognizing Your Digital Friends, Encryption for Peer-to-Peer Social Networks Crowd sourcing and Ethics, Authors: Altshuler Y, EloviciY, Cremers A.B, Aharony N, Pentland A. (Eds.).
2. Social media security
   https://www.sciencedirect.com/science/article/pii/B9781597499866 0000

REFERENCE BOOKS:

1. Michael Cross, Social Media Security Leveraging Social Networking While Mitigating Risk.
2. Online Social Networks Security, Brij B. Gupta, SomyaRanjanSahoo, Principles, Algorithm, Applications, and Perspectives, CRC press.

19CY4265: DATA PRIVACY (Open Elective – III)

B.Tech.IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. The objective of this course is to create architectural, algorithmic and technological foundations for the maintenance of the privacy of individuals.
2. Students are able to learn the concepts of confidentiality of organizations, and the protection of sensitive information, despite the requirement that information be released publicly or semi-publicly.

Course Outcomes:

1. Discuss the concepts of privacy in today's environment.
2. How automation is changing the concepts and expectations concerning privacy and the increasingly interconnected issue of security.
3. Explain the knowledge of the role of private regulatory and self-help efforts.
4. How emerging issues are affecting society and business, with a concentration on how information security must shape corporate practices.

UNIT - I:
Introduction- Fundamental Concepts, Definitions, Statistics, Data Privacy Attacks, Data linking and profiling, access control models, role-based access control, privacy policies, their specifications, languages and implementation, privacy policy languages, privacy in different domains- medical, financial, etc.

UNIT - II:

Data explosion- Statistics and Lack of barriers in Collection and Distribution of Person- specific information, Mathematical model for characterizing and comparing real-world data sharing practices and policies

and for computing privacy and risk measurements, Demographics and Uniqueness

Protection Models- Null-map, k-map, Wrong map

UNIT - III:
Survey of techniques- Protection models (null-map, k-map, wrong map), Disclosure control, Inferring entity identities, Strength and weaknesses of techniques, entry specific databases.

UNIT - IV:

Computation systems for protecting delimited data- MinGen, Datafly, Mu-Argus, k- Similar, Protecting textual documents: Scrub.

UNIT - V:
Technology, Policy, Privacy and Freedom- Medical privacy legislation, policies and best practices, Examination of privacy matters specific to the World Wide Web, Protections provided by the Freedom of Information Act or the requirement for search warrants.

TEXT BOOKS:

1. B. Raghunathan, The Complete Book of Data Anonymization: From Planning to
   Implementation, 1st Edition, Auerbach Pub, 2013.

2. L. Sweeney, Computational Disclosure Control: A Primer on Data Privacy Protection, MIT Computer Science, 2002.

REFERENCE BOOKS:

1. NishantBhajaria Data Privacy: A runbook for engineers, Manning Publications.
2. Gwen Kennedy, Data Privacy Law: A Practical Guide to the GDPR, ISBN-13: 978-0999512722, ISBN-10: 0999512722.

19CY4266: 5G TECHNOLOGIES (Open Elective – III)

B.Tech.IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on the concepts of 5G and 5G technology drivers. Understand 5G network architecture, components, features and their benefits.

Course Outcomes:

1. Understand 5G and 5G Broadband Wireless Communications.
2. Understand 5G wireless Propagation Channels.
3. Understand the significance of transmission and Design Techniques for 5G.
4. Analyze Device-to-device (D2D) and machine-to-machine (M2M) type communications.
5. Learn Massive MIMO propagation channel models.

UNIT - I:
Overview of 5G Broadband Wireless Communications: Evolution of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.

UNIT - II:
The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mmWave MIMO Systems.,3GPP standards for 5G

UNIT - III:
Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency

division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).

UNIT - IV:
Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi operator D2D communications.

UNIT V:
Millimeter-wave Communications – spectrum regulations, deployment scenarios, beam-forming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).

TEXT BOOKS:
1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. AfifOsseiran, Jose. F. Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press.

REFERENCE BOOKS:
1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
2. Amitabha Ghosh and RapeepatRatasuk "Essentials of LTE and LTE-A", Cambridge University Press.
3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.
4. Theodore S. Rappaport, Robert W. Heath, Robert C. Danials, James N. Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Computer Science and Business Systems)

Open Elective – I

19BU3261 - Operation Research - II

B.Tech.III Year II Sem.

	L	T	P	C
	3	0	0	3

Course Objectives: Knowledge on concepts of optimization techniques, formulation of a LPP, Non- linear programming concepts

Course Outcomes: At the end of the course, the student should be able to

- Apply the dynamic programming to solve problems of discreet and continuousvariables.
- Apply the concept of non-linearprogramming
- Carry out sensitivityanalysis
- Model the real-world problem and simulateit.

UNIT - I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT - II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT-III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT – IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models.

UNIT - V

Competitive Models, Single and Multi-channel Problems, Dynamic Programming, Flow in Networks, Elementary Graph Theory.

TEXT BOOKS:

1. H.A. Taha, Operations Research, An Introduction, PHI,2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi,1982.

REFERENCE BOOKS:

3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,2008

4. Hitler Libermann Operations Research: McGraw Hill Pub.2009
5. Pannerselvam, Operations Research: Prentice Hall of India2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

19BU3262 - Cloud Computing

B.Tech.III Year II Sem.

	L	T	P	C
	3	0	0	3

Pre-Requisites: courses on Computer Networks, Operating Systems, Distributed Systems.

Course Objectives: The objective of this course is to

1. This course provides an insight into cloudcomputing
2. Topics covered include- distributed system models, different cloud service models, service-oriented architectures, cloud programming and software environments, resourcemanagement.
3. The fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and futurechallenges
4. Cloud storage technologies and relevant distributed filesystems
5. The basic ideas and principles in data center design; cloudmanagement techniques and cloud software deploymentconsiderations

Course Outcomes: At the end of this course the students will be able to

1. Abilityto understandvariousservicedeliverymodelsofacloudcomputing architecture.
2. Ability to understand the ways in which the cloud can be programmedand deployed.
3. Understanding cloud serviceproviders.
4. Ability to understand network and storage virtualization and outline their rolein enabling the cloud computing systemmodel.
5. Analyze various cloud programming models and apply them to solve problemson the cloud.

UNIT – I
Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

UNIT – II
Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud

Deployment Models

UNIT – III

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications, on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure Managing the Cloud application, Migrating ApplicationtoCloud,PhasesofCloudMigrationApproachesforCloudMigration.

UNIT – IV

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.
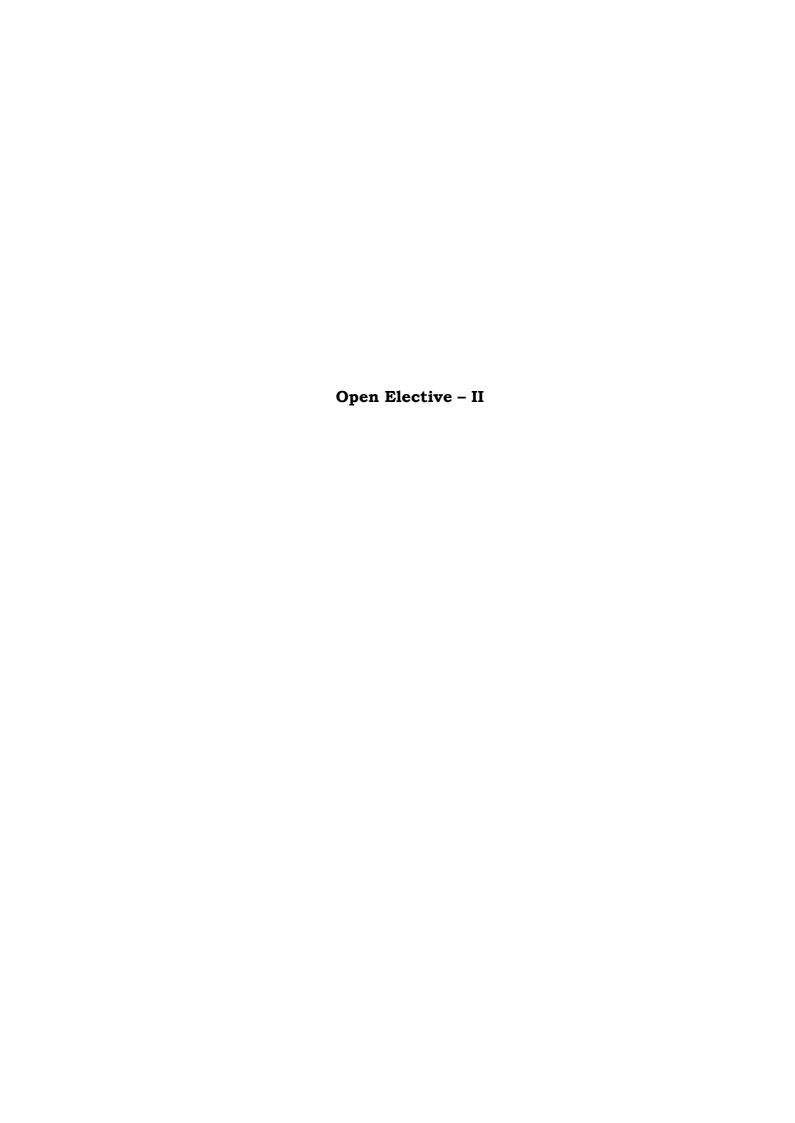
UNIT V

Cloud Service Providers: EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue ,service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP LaBU, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rack space, VMware, Manjra soft, Aneka Platform

TEXT BOOK:

1.   Essentials of cloud Computing: K. Chandrasekhran, CRC press,2014

REFERENCE BOOKS:

1. Cloud Computing: Principles and Paradigms by RajkumarBuyya, James Broberg and Andrzej M. Goscinski, Wiley,2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier,2012.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp2011.

Open Elective – II

19BU4163 - R-Programming

B.Tech.IV Year I Sem.	L	T	P	C
	3	0	0	3

Course Objectives:

1. Understanding and being able to use basic programmingconcepts
2. Automate dataanalysis
3. Working collaboratively and openly oncode
4. Knowing how to generate dynamicdocuments
5. Being able to use a continuous test-driven developmentapproach

Course Outcomes:

1. Understand to use and program in the programming language R
2. Understand to use Control structures, functions and vectoroperations.
3. Implementing various data types like List and applying them on dataframes
4. Implement Factors andTables
5. Implement plotting Graphs and Debuggingtechniques

UNIT – I
Introduction: Overview of R, R data types and objects, sub setting, R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Logical operations.

UNIT – II
Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes, Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations.

UNIT – III
Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List, Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List, Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames.

UNIT - IV

Factors and Tables: Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for StatisticalDistributions.

UNIT - V

Graphics: Creating Graphs, Customizing Graphs, Saving Graphs to Files, Customizing Graphs, Creating Three-Dimensional Plots.

TEXT BOOKS:
1. R Programming for Data Science by Roger D.Peng
2. The Art of R Programming by Norman Matloff Cengage LearningIndia.

REFERENCE BOOKS:
1. **Hadley Wickham, Garrett Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition, O'Reilly.**
2. Tilman M. Davies, The book of R a first course in programming and statistics, no starchpress.

19BU4164 - Design Thinking

B.Tech.IV Year I Sem.

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:
1. To inculcate core design principles and applied creativity to develop innovative strategies that better connect engineers with their endusers
2. To build mind-set leading to flow of creative ideas, validating those ideas and prioritizing the bestones
3. To incorporate tools that designers need to take a design project from inspiration and insights to ideation andimplementation
4. To instil full scope of organizational innovation and strategy through knowledge, insight and analyticalskills
5. To Identify and resolve issues with working in diverseteams

COURSE OUTCOMES: After completion of the course, the student should be able to

1. Use design thinking and hypothesis-driven innovation processes to develop viable solutions to userchallenges
2. Use multiple brainstorming techniques to find innovativesolutions
3. Develop and test a business model or business case to support the viability of the solution
4. Prototype a solution to a userchallenge
5. Investigate the cultural, emotional, technological and business factors relevant to developing new product or service designconcept

UNIT-I

Revisiting Design Thinking: Creative thinking as basis of innovation; Empathy process for deep understanding of challenge with practical ingenuity; Making sense of observations and insights; Defining a point of view and context Design thinking skills for Problem Discovery, Definition, and Ideation – Identifying problems in daily lives and in the world at large, Understanding user and customer perspectives, Thinking from the problem before thinking of a solution

UNIT-II

Ideation Process: Clear Articulation of problem statement with focus on latent needs;Brainstormingpotential solutions; Ideation methods with case-study based approach to using Systematic Inventive Thinking (SIT) Methods such as Addition, Subtraction, Multiplication, Division and Task

Unification Strategic Innovation for competition in future: Linear Innovation vs. non-linear innovation, Understanding and identifying weak signals, 3-box thinking, 3-Box framework and Box-3ideation

UNIT-III

Designing Customer Experience: Understanding Innovation through Design Thinking; Enhancing Customer Experience; Service Design and Development Process and Case Studies; Service Experience Cycle and Case Studies

UNIT-IV

Sustainable Design Approaches: Concern for Environment and Sustainability in Design, Case Studies to understand good Design for Environment (DFE) Decisions; Design Considerations in the five stages of the Product Life Cycle.
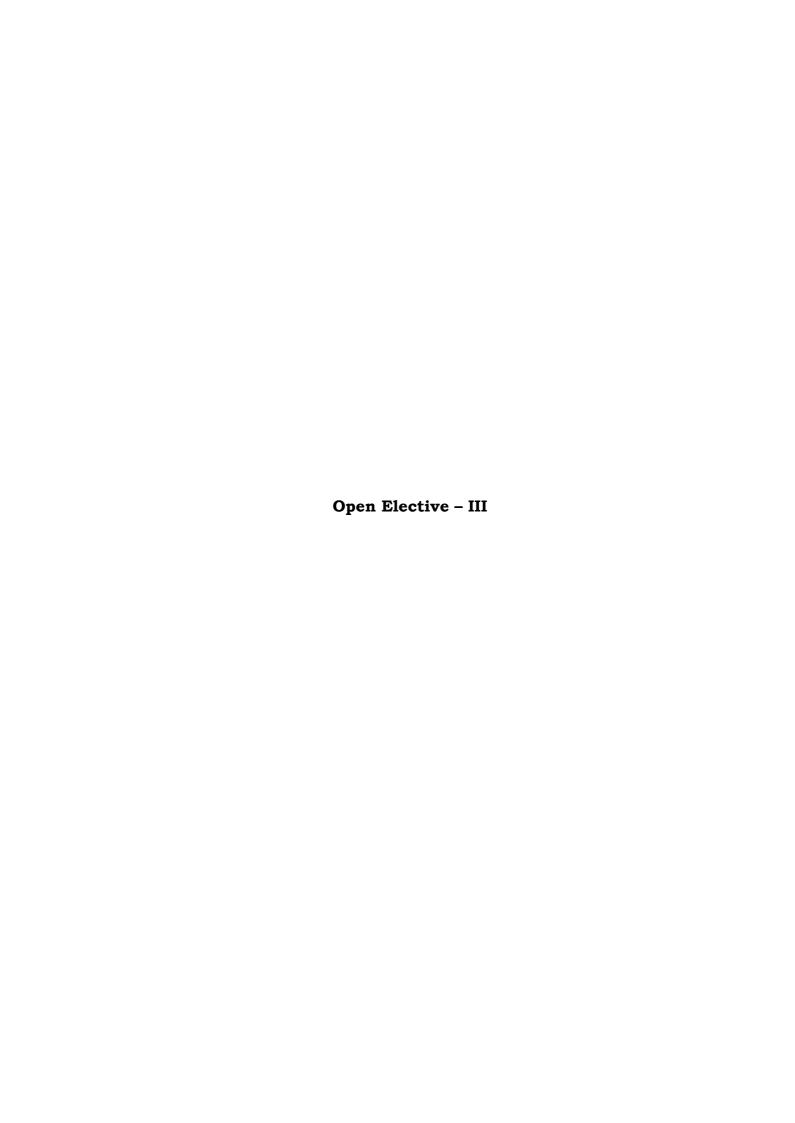
UNIT-V

Integrative Engineering Design Solutions: Identifying and resolving issues with working in diverse teams, Modularising, prototype building by different engineering disciplines within the team, validated learning with accessible metrics, Capstone Project (Interdisciplinary) Applying Design Thinking Principles and Methods for Ideation and Prototyping, Testing Solution, Refining Solution, and Taking the Solution to the Users

TEXT BOOKS:
1. 101 Design Methods: A Structured Approach for Driving Innovation in your organization, Vijay Kumar, John Wiley & Sons, ISBN: 978-1118083468,2012
2. Living with Complexity, Donald A Norman, MIT Press, ISBN: 978-0262528948, 2016
3. Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work, Beverly Rudkin Ingle, A Press, ISBN: 978-1430261810,2013

REFERENCE BOOKS:
1. Emotionally Durable Design: Objects, Experiences and Empathy, Jonathan Chapman, 2nd Edition, Routledge, ISBN: 978-0415732161,2015
2. Innovation Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions, Thomas Lockwood, Edgar Papke, New Page Books, ISBN: 978-1632651167,2017
3. Design Thinking Business Analysis: Business Concept Mapping Applied, Thomas Frisendal, Springer, ISBN: 978-3642434822,2012

4. Chapter 1: A Simple Framework for Leading Innovation, The Three Box Solution, HBR Press,2016
5. Design a Better Business: New Tools, Skills and Mindset for Strategy and Innovation, Patrick Van Der Pijl, Justin Lokitz, Lisa Kay Solomon, Erik van der Pluijm, Maarten van Lieshout, Wiley, ISBN: 978-8126565085,2016

Open Elective – III

19BU4265 - Innovation IP Management &Entrepreneurship

B.Tech.IV Year II Sem.

	L	T	P	C
	3	0	0	3

Course Objectives:
1. To develop Entrepreneurship skills of students by enriching knowledge about substantive aspects of management, strategy and legalliterature.
2. To discuss intellectual property strategy to protect inventions and innovations of newventures.
3. The course will make the students understand the different types of IP and make them aware of IPProtection.
4. The course will enable students to strategize IP lifecycle effectively throughout the journey of start-up, in a time when it is aspired highly by the economy and society.
5. Students will learn the fundamentals and advanced strategies of IP. They will be given the opportunity for understanding the same in the MSME sector. They will finally be provided brief exposure about the valuation techniques and audits ofIP.

Course Outcomes:
1. Describe the requirements and responsibilities put on management, board members and shareholders in different developmentsituations
2. define the needs for resources as well as obstacles in the early stages of the development of abusiness
3. independently formulate a business plan based on a business idea intechnology
4. students will be able to plan and implement a development project in ateam
5. Describe the fundamentals of intellectual property rights and legislation, particularly in the biotechindustry.

UNIT - I:

Entrepreneurship: Introduction, Relation between IP and Entrepreneurship, Role of IP identifying threshold innovative entrepreneurs. Innovative entrepreneurship, Opportunity recognition and entry strategies. Competitive advantage through IP protection, IP protection for Start-ups.

UNIT - II:

Innovation: Introduction to innovation, Creativity, Different types of innovation, Open innovation, Adaptability of an innovation, Innovation vs. Invention, Divergent and convergent thinking, Idea generation, Idea validation, Idea protection, Necessity of innovation in current businessworld.

UNIT - III:

Intellectual Property: Introduction, Traditional knowledge vs. Intellectual Property, Different types of IP, Copyrights, Trademarks, Geographical Indications, Trade secrets, Patents; Transforming IP into Economy; IP protection in developed nations, and developingnations. Position of India in IP protection (Agriculture, Pharmaceutical and engineering sectors).

UNIT - IV:

IPR and Technical Inventions: Patent, Patentability requirements, Patent drafting, Patent lifecycle; Software Patents: Design Patents; Protection of Various aspects of Embodied Inventions; Integrated circuit designs protection; Software Inventions or algorithms: Copyright vs Patent.

UNIT - V:

IP strategy and Entrepreneurship: IP strategy for start-up and MSME, IP transaction, IP valuation, Government Initiatives: Incubators, research parks, Various Government policies, Integrative approach – Entrepreneurship & IP strategy, Fee relaxations for patents for Start- ups and small entities.

TEXT BOOKS:
1. Ove Granstrand, The Economic and management of Intellectual Property,(1999)
2. Narayanan, V. K., Managing technology and innovation for competitive advantage, first edition, Pearson education, New Delhi,(2006)
3. Idris, K. (2003), Intellectual property: a power tool for economic growth, second edition, WIPO publication no. 888,Switzerland
4. Bosworth D. &WeBUter E, The Management of Intellectual Property, EdwardElgar.

REFERENCE BOOKS:
1. Berman, Ideas to Assets, Wileypublications
2. Richard Dorf& Thomas Byers, Technology ventures from idea to enterprise, 2 ndedition.

ADDITIONAL READING:WIPO - http://www.wipo.int/patents/en/

19BU4266 - Social Media Analytics

B.Tech.IV Year II Sem.

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Course Objectives:

1. To enable students to understand its fundamental concepts of Social Media and Social Networkingsystems.
2. To understand and analyze social Media analytics andtools.
3. To study its various types of Social Media textanalytics.
4. To understand and analyze social Media Actions, ActionsAnalytics.
5. To study its various types of Hyperlink Analytics, HyperlinkAnalytics.

Course Outcomes:

1. The students will be able to understand its fundamental concepts of Social Mediaand Social Networkingsystems.
2. The students will be able to gain knowledge on layers of Social Mediaanalytics.
3. The students will be able to apply text analytics tools on Social Mediadata.
4. The students will be able to know the importance of Social Media action and action analytics.
5. The students will be able to understand and analyse various types of Hyperlink Analytics, HyperlinkAnalytics

UNIT - I:
Introduction to Social Media: World Wide Web, Web 1.0, Web 2.0, Web 3.0, Social Media, Core Characteristics of Social Media, Types of Social Media, Social Networking Sites, Using Facebook For Business Purposes, Content Communities.

UNIT- II:
Social Media Analytics Overview: Purpose of Social Media Analytics, Social Media Vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media AnalyticsTools.
Case Study: The Underground Campaign That Scored Big

UNIT - III:
Social Media Text Analytics: Types of Social Media Text, Purpose of Text

Analytics, Steps in Text Analytics, Social Media Text Analysis Tools.Case Study: Tapping into Online Customer Opinions

UNIT -IV:
Social Media Actions Analytics: Introduction to Actions Analytics, Common Social Media Actions, Actions Analytics Tools.Case Study: Cover-More Group

UNIT - V:
Social Media Hyperlink Analytics: Types of, Types of Hyperlink Analytics, Hyperlink Analytics Tools.Case Study: Hyperlinks and Viral YouTube Videos

TEXT BOOK:
1.   Seven Layers of Social Media Analytics Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, And Location Data by Gohar F. Khan ISBN: 1507823207, Isbn-13:9781507823200

REFERENCE BOOKS:
1.   Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media by Matthew Ganis, AvinashKohirkar, PearsonEducation.
2.   Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Marshall Sponder,MGH.
3.   Big   DataandAnalytics,Seema   Acharya, SubhasininChellappan,   Wiley Publications.
4.   Big Data, Black Book^{tm}, Dreamtech Press, 2015Edition.