Detailed Syllabus
Lecture-wise Breakup

Course Code	17M21CS121	**Semester:** Even	**Semester:** II **Session:** 2020 -2021 **Month from** Jan 2021 to June 2021
Course Name	CLOUD BASED BIG DATA SYSTEMS II		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr K. Rajalakshmi
	Teacher(s) (Alphabetically)	Dr. K. Rajalakshmi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Outline and classify cloud based big data systems on basis of their features and applicability	Understand (C2)
CO2	Apply MongoDB commands to define, query, manipulate and analyze big data.	Analyze (C4)
CO3	Manage Big Data and perform data analysis by loading and querying data using Hive	Analyze (C4)
CO4	Utilize HBase for random, real-time read/write access to big data.	Apply (C3)
CO5	Design a real-world application by using MongoDB or HBase as the database	Create (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Cloud Based Data Stores	Cloud database architecture, Review of NoSQL systems: classification and applications, CAP Theorem	4
2.	Cloud Computing for Big Data Applications	Features of CC, Virtualization for Cloud databases, Amdahl's & Gustafson's law, Transactional models for Cloud Based Applications	4
3.	Document Data Stores	Characteristics of big data applications, Need for document based data stores, MongoDB: documents, CRUD operations, aggregation operations, indexes , replication and sharding	8
4.	Hadoop Framework	Architecture, Key Components, Data Analytics with Hadoop Hive: File Formats, HiveQL, Partitioning and Bucketing, Indexing etc	6
5.	Map reduce Programming Model	Map Reduce programming, MR with MongoDB	3
6.	Columnar, Key Value and Graph Databases	Overview and use of HBase , Redis and Neo4j Databases	6
7.	Multi-tenancy in Cloud Computing	Multi-tenant Database Architecture, Schema Evolution for Shared Databases, Schema mapping techniques for shared database and shared tables	3
8.	DBaaS	Database As a Service, Using Mongo Atlas Service	2

9.	Big Data Programming models	Map reduce vs vertex centric vs data flow models	2
10.	Interoperability and Monitoring of cloud environment	Interoperability of Cloud Storage Systems, Monitoring and Control of Cloud/Big Data solutions	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance = 07, Quizzes /Assignments /Mini-Project = 18)
Total	**100**

Project based learning: Students form group of size 2-3 members. Each group will identify big data applications in various thrust areas like healthcare, industrial, education, smart city, logistics, environment, governance and etc. Once problem is identify, the group will analyze the problem and synthesize big data system based solutions to the identified problem. Each group will apply different big data approaches such as data store, indexing, multi tenancy, cloud computing platforms and etc. This approach will enhance skills of each students to analyze, syntheses the solutions, designing and developing of Cloud based big data system based solutions to real world problems. Further, these approaches promote the students towards their employability opportunity into data analyst, data scientists, and computer engineering and information technology sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

	Reference Books
1.	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
2.	David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph”, Morgan Kaufmann/El sevier Publishers, 2013
3.	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015
4.	Kim H. Pries and Robert Dunnigan, “Big Data Analytics: A Practical Guide for Managers ” CRC Press, 2015
5	Jimmy Lin and Chris Dyer, “Data-Intensive Text Processing with MapReduce”, Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010

Detailed Syllabus
Lab-wise Breakup

Course Code	17M25CS121	**Semester:** Even	**Semester:** II **Session:** 2020 -2021 **Month from** Jan 2021 to June 2021
Course Name	Cloud Based Big Data Systems Lab-II		
Credits	1	**Contact Hours**	0-0-2

Faculty (Names)	**Coordinator(s)**	Dr Parmeet Kaur
	Teacher(s) (Alphabetically)	Dr Parmeet Kaur

COURSE OUTCOMES		**COGNITIVE LEVELS**
C175.1	Outline and classify cloud based big data systems on basis of their features and applicability	Understand Level (C2)
C175.2	Apply MongoDB commands to define and query big data.	Apply Level (C3)
C175.3	Analyze big data with aggregation and Map Reduce frameworks of MongoDB.	Analyze Level (C4)
C175.4	Analyze big data by loading and querying operations of Hadoop Hive	Analyze Level (C4)
C175.5	Assess performance of Hadoop HBase for random, real-time read/write access to big data.	Evaluate Level (C5)
C175.6	Develop a real-world application by using MongoDB or HBase as the database	Create Level (C6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Review of Cloud Based Big Data Systems	1. Investigate the concept of Database as a Service. 2. Setup a MongoDB Atlas database cluster.	CO1
2.	GUI based Big Data Analytics platforms	3. Set up a data analytics workflow on KNIME platform.	CO1
3.	Introduction to MongoDB	4. Install MongoDB, Perform MongoDB CRUD operations	CO2, CO6
4.	Aggregation with MongoDB	5. Perform data analysis with MongoDB aggregation operators 6. Perform data analysis with MongoDB Map Reduce framework	CO3, CO6
5.	Introduction to Hadoop Hive	7. Load big data into Hive warehouse 8. Perform queries on data in Hive	CO4, CO6
6.	Scaling with Hive	9. Partition big data present in Hive Warehouse 10. Cluster big data present in Hive Warehouse	CO4, CO6
7.	Working with HBase	11. Insert data in real time into HBase 12. Query data in real time from HBase	CO5

Evaluation Criteria

Components	**Maximum Marks**
1. Lab Test1	20
2. Lab Test 2	20
3. Lab Assignments	25

4. Project	25
5. Attendance	10
Total	**100**

Project based learning: Each student in a group of 2-3 will develop a solution to a big data problem of their choice. They will implement a cloud based big data system for storage, querying and analysis of data related to the selected problem. The students will develop a complete solution for a comprehensive understanding of the cloud based big data systems that will enhance the students' employability into cloud and big data sectors of IT industry.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Zikopoulos, Paul, and Chris Eaton. Understanding big data: Analytics for enterprise class hadoop and streaming data. McGraw-Hill Osborne Media, 2011.
2.	Banker, Kyle. MongoDB in action. Manning Publications Co., 2011.
3.	Chodorow, Kristina. Scaling MongoDB: Sharding, Cluster Setup, and Administration. " O'Reilly Media, Inc.", 2011.
4.	Holmes, Alex. Hadoop in practice. Manning Publications Co., 2012.
5.	Lam, Chuck. Hadoop in action. Manning Publications Co., 2010.

Detailed Syllabus
Lab-wise Breakup

Course Code	17M25CS112	**Semester:** Even	**Semester:** II **Session:** 2020-21 **Month from** Jan 2021 to June 2021
Course Name	Advanced Machine Learning Lab		
Credits	1	**Contact Hours**	0-0-2

Faculty (Names)	**Coordinator(s)**	K Vimal Kumar
	Teacher(s) (Alphabetically)	K Vimal Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C180.1	Use Python for implementing fundamental machine learning algorithms	Understand Level (Level 2)
C180.2	Deploy Neural Network with TensorFlow by accessing and understanding the files that make up a trained model.	Apply Level (Level 3)
C180.3	Apply Deep Learning Neural networks to model object detection, video tagging, music genre detection etc.	Apply Level (Level 3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Python Fundamentals	To write a program for writing the pixel values of an image	C180.1
2.	Python Fundamentals	Write programs for Data Sampling and Visualization	C180.1
3.	Python Fundamentals	Use IPython (a web version provided by Jupyter nootbook) to write a word count program. Your program should read a text document (download from https://raw.githubusercontent.com/python/cpython/master/	C180.1
4.	Python Fundamentals	Implement neural networks for Classification of *four* character patterns	C180.1
5.	TensorFlow	For the data based on 1990 census data from California, evaluate the accuracy of a model's predictions using RMSE.	C180.2
6.	TensorFlow	Improve the accuracy of a model of 6 above, by tuning its hyperparameters	C180.2
7.	CNN	Implement CNN using TensorFlow for classifying MNIST images	C180.3
8.	Deep Learning	Use deep learning for music genre classification	C180.3
9.	Deep Learning	Implement AlexNet, GoogleNet and VGGNet and report their relative performance on same dataset.	C180.4

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Evaluation	20
Periodic Evaluations	20
End Term Test	20
Viva	10
Mini Project	30
Total	**100**

Recommended Reading material:	
1.	Martin C. Brown, Python: The Complete Reference Paperback, Mc.Grow Hill, 2001
2.	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Orielly, 2018.

Detailed Syllabus
Lab-wise Breakup

Course Code	17M25CS213	**Semester:** Even	**Semester:** II **Session:** 2020-2021 **Month from** Jan 2021 to June 2021
Course Name	Data Science Programming Lab-II		
Credits	1	**Contact Hours**	0-0-2

Faculty (Names)	**Coordinator(s)**	Neetu Sardana
	Teacher(s) (Alphabetically)	Neetu Sardana

COURSE OUTCOMES		**COGNITIVE LEVELS**
C172.1	Applying the basic syntax used for data manipulation in Python	Apply Level (C3)
C172.2	Apply different methods for Exploratory Data Analysis	Apply Level (C3)
C172.3	Apply different metrics for distance calculation	Apply Level (C3)
C172.4	Apply and Compare different classification and clustering techniques.	Apply Level (C3)
C172.5	Analyze the real-world problem to identify the appropriate data science techniques for classification or clustering.	Analyze Level (C4)

Module No.	**Title of the Module**	**List of Contents**	**CO**
1.	Python fundamentals	Dictionary, List, Sets, Tuples; Handling arrays using Numpy, Data analysis with pandas, Data Frames, Matrix multiplication, String handling Inserting and exporting data: CSV, XLS, JSON.	C172.1
2.	Data Preprocessing	Data cleaning, Checking the missing data, Filling the missing data. String operations, Merging data, Data operations, Aggregation operations. Inferential Statistics, Various forms of distribution: Normal, Poisson, Chi Square	C172.2
3.	Exploratory Data Analysis	Analyzing univariate data graphically, Grouping the data and using dot plots, scatter plots for multivariate data, heat maps, box-and-whisker plot Analyzing Unstructured Data with Text Mining: create word cloud, Tokenization, removing stop words, Stemming the words, word lemmatization, Representing the text as a bag of words, TF-IDF	C172.2
4.	Distance Metrics	Working with different distance measures: Manhattan distance, Euclidean distance, Minkowski distance, Chebyshev distance. Working with similarity measures in data points: Cosine similarity, Jaccard similarity. Finding outliers in univariate data.	C172.3
5.	Machine Learning using Python	Data preparation, creating training and testing sets, building a model, Model evaluation, evaluating a model based on test data, Model building and evaluation with SciKit.	C172.4

		Supervised learning: Decision trees, Linear regression: Simple and Multiple and Logistic regression, Naive Bayes; ANN. Unsupervised learning: The k-means clustering, Hierarchical clustering	
6.	Mini Project	1.Identify the broad topic of your mini project based on the Data Science. 2. Study minimum 8 quality research papers based on the selected topic. 3. Do the SWOT analysis of selected research papers/reports. 4. Identify the research problem. 5. Design the architecture for the proposed problem. 6. Implement and propose your novelty/improvement in terms of algorithm/new feature. 7. Design the test bed. 8. Design a set of experiments to be carried out for the proposed problem. 9. Perform the experimental analysis (in Python language only). 10. Write a short research paper based on your contribution (10-20 pages).	C172.5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test1	20
Lab Test2	20
Mini Project	30
Regularity and performance	30 (Attendance: (10) Assignments/ MiniP roject/ Quiz:(20))
Total	**100**

Project Based Learning: Project-based learning is the key in fully understanding the data science process. Each student in a group of 2 will choose a real-world problem. Each group will define feature engineering techniques. They will analyse the data using visualization strategies. Model will be created using machine learning techniques. Each group will evaluate the performance of the models applied and present the interpretation of the results. The project will be done in Python.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Gopi Subramanian, Python Data Science Cookbook, PACKT publishing, 2015.
2.	Samir Madhavan, Mastering Python for Data Science, PACKT publishing, 2015.
3.	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
4.	Pujari, Arun K, Data mining and statistical analysis using SQL, Universities press, 3rd edition, 2013
5.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, second edition, 2019.
6.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
7.	David Hand, Heikki Mannila and Padhraic Smyth, Principles of Data Mining, PHI
8.	Transactions on Database Systems (ACM)
9.	IEEE Transactions on Knowledge & Data Engineering

Detailed Syllabus
Lecture-wise Breakup

Course Code	18M12CS115	**Semester:** Even	**Semester:** II **Session:** 2020 -2021 **Month from** Jan 2021 to June 2021
Course Name	Internet of Things		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Chetna Dabas
	Teacher(s) (Alphabetically)	Dr. Chetna Dabas, Dr K. Rajalakshmi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C150.1	Identification of purpose, requirements and description of various components and specifications of IoT devices, applications and protocols.	Understand (level 2)
C150.2	Develop the Process Model, Domain Model, Information Model and Service Model specifications using IoT communication protocols.	Apply (level 3)
C150.3	Analyze the characteristics and functioning of various IoT specific communication protocols used in different layers of IoT devices.	Analyze (level 4)
C150.4	Evaluate various IoT protocols and components for building IoT applications for real world problems and sustainable solutions.	Evaluate (level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Internet of Things	Introduction to Internet of Things, Layers in IoT, IoT Communication Protocols at different layers, Design steps for IoT, IoT Enabling Technologies, IoT Levels.	5
2.	IoT platforms design methodology	IoT Design methodology, Purpose and requirement specifications, Process, Domain, Information Model specifications, Service specifications and application development.	5
3.	IEEE 802.15.4	The Physical Layer, MAC Layer, MAC Layer Frame Format and their uses.	3
4.	ZigBee	ZigBee Architecture, Association, ZigBee Network Layer, APS Layer, ZDO, Security, ZCL etc.	3
5.	Internet Connecting Principles	Introduction to Arduino and Raspberry Pi, Connectivity with other components, internet connectivity, IP addressing in IoT, Media Access Control, and Application Layer Protocols: MQTT, CoAP, XMPP.	7
6.	Design Principles for Web Connectivity	Web Communication Protocols for Connected Devices, Message communication Protocols, Web connectivity : SOAP, REST, HTTP RESTFUL, Web Sockets	4
7.	Data Acquiring , Organizing, Processing and	Data Acquiring and Storage, Organizing the data, Transactions, Business Processes, Integration and Enterprises Systems, Analytics, Knowledge Acquiring,	4

	Analytics	Managing and Storing process	
8.	Data Collection, Storage and Computing using Cloud Computing	Cloud computing paradigms for Data Collection, Storage and Computing, Cloud Service Models, IoT Cloud-based Services.	6
9.	IoT Applications for Sustainable developments.	Energy Savings in IoT, Green IoT Applications developments for sustainability.	3
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Presentations of assigned topics)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Internet of Things: A Hands-On Approach, Arshadeep Bagha and Vijay Madisetti.
2	The Internet of Things: Key Applications and Protocols, Oliver Hersent, David Boswarthick, Omar Elloumi, Wiley.
3.	Internet of Things: Architecture and Design Principles, Raj Kamal, McGrawHill
4.	6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
5.	Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, Daniel Minoli John Wiley & Sons

Detailed Syllabus
Lecture-wise Breakup

Subject Code	19M12CS211	**Semester:** Even	**Semester:** II **Session:** 2020-2021 **Month from** Jan 2021 to June 2021
Subject Name	Nature Inspired Computation and Applications		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Anuja Arora
	Teacher(s) (Alphabetically)	Dr. Anuja Arora

COURSE OUTCOMES		**COGNITIVE LEVEL**
CS151.1	Identify the need of computational complexity, evolutionary, and approximate algorithms.	Apply Level (Level 3)
CS151.2	Understand nature inspired algorithms, its strength, weakness, and suitability	Understand Level (Level 2)
CS151.3	Make use of nature-inspired algorithms to design, learn and optimize problem	Apply Level (Level 3)
CS151.4	Evaluate performance of Nature inspired algorithm in context of problem solving in optimized manner	Evaluate Level (Level 5)
CS151.5	Create a real environment effective artificial system with the use of properties exhibited from nature.	Create Level (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Nature Inspired Computation Fundamental	Computational Complexity, NP-Hardness, Reductions, Approximation Algorithms vs. Heuristics, Newton Raphson Method, Characteristics of Natural Systems/Algorithms	3
2.	Empirical and Evolutionary Algorithms	Empirical Algorithms, Empirical hardness. Evolutionary Algorithms, optimization Fitness landscape Analysis, EA Theory	4
3	Evolutionary Algorithms	Genetic Algorithm, GA Encoding Techniques, Selection techniques, Variation(Crossover and Mutation) Techniques, Genetic Programming Differential Evolution Algorithm, sample problems, DE-Crossover and Mutation techniques	8
4	Swarm Intelligence Algorithm	Particle Swarm Optimization Binary PSO Ant Colony Optimization Artificial Bee Colony Algorithm, Cuckoo Search Firefly Algorithm BAT Algorithm	17

5	Miscellaneous Optimization Algorithm	Gravitational Search Algorithm Teaching Learning Based Optimization Nondominated sorting genetic algorithm II (NSGA-II) Artificial Immune System Self-organizing Maps	8
11	NIC in Real Context	Constraint Handling, Parallelization and vectorization of Fitness Function. Case Studies: World Wide Web, Social Network, Modeling, Image Processing, Earthquake, routing & scheduling	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance = 10 Class Test/Quiz = 10 Mini-Project = 5
Total	**100**

Project Based Learning: Students will form a group of 2-3 students. To design a problem statement, students read 4-5 research papers in which nature inspired computational algorithms have been used to handle real scenario problems. Theme and topic of project is chosen based on read research papers. Understanding usage of appropriate optimization technique, then implementation of the selected optimization algorithm and evaluating its effectiveness based on performance measure help students to know the concept of applying the optimization techniques in real life case scenario.

Text Books Books	
1.	Evolutionary Optimization Algorithms, D. Simon (2013), Wiley.
2.	Yang, X. S. (Ed.). (2017). Nature-inspired algorithms and applied optimization (Vol. 744). Springer.
Reference Books	
1.	Eberhart, Russell C., and Yuhui Shi. Computational intelligence: concepts to implementations. Elsevier, 2011
2.	Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, D.Floreano and C. Mattiussi (2008), MIT Press.
3.	Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
4.	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
5.	Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005
6.	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
7.	Coello, C. C., Dhaenens, C., & Jourdan, L. (Eds.). (2009). Advances in multi-objective nature inspired computing (Vol. 272). Springer.

Detailed Syllabus
Lecture-wise Breakup

Course Code	21M21CS123	**Semester:** Even	**Semester:** II **Session:** 2020-2021 **Month from** Jan 2021 to June 2021
Course Name	Essential Statistics for Data Science		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Megha Rathi
	Teacher(s) (Alphabetically)	Dr. Anuja Arora, Dr. Megha Rathi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C184.1	Understand the basic principle of probability and statistics and its need in the context of data science	Understand Level (Level 3)
C184.2	Develop own statistical analyses and implement them with advanced statistical programming tools	Apply Level (Level 3)
C184.3	Compare the performance of multiple statistical methods and models and articulate the limitations and abuses of formal inference and modeling.	Analyze Level (Level 4)
C184.4	Evaluate statistical techniques for constructing learning models and can use different measures of model fit and performance to assess models.	Evaluate Level (Level 5)
C184.5	Create real world applications using statistical or data modeling techniques and test hypothesis.	Create Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Probability and Statistical inference	Modern Statistics, Statistics and Engineering, Probability, Conditional Probability, The Axioms of Probability, Sampling, Randomness, Intro to Statistics: Mean and V ariance, Covariance, Types of Convergence.	6
2.	Statistical Methods in Data Science	Data Distribution (Bernoulli, Uniform, Binomial, Normal, Poisson), Mathematical Statistics, Inferential Statistics, Descriptive Statistics, Random Variable,Gauss-Markov theorem, F-distribution	7
3	Hypothesis Testing	Hypothesis Testing, Difference of Means, Significance Level and P-Value, Z-test, ANOVA,T-Test, Redundancy Test, Chi-Square & F-test, Type-I and Type-II errors	7
4.	Data Modeling	Cross validation, Monte Carlo methods, Cluster analysis, Time Series Modeling	6
5.	Introduction to Bayesian Modeling	Bayes' Theorem, Conditional Statements, Bayesian Thinking: priors, posteriors, and Maximum Likelihood Estimation, Bayesian inference	5
6.	Correlation & Regression Models	Correlation Analysis, Linear regression methods, Ridge regression, LASSO Regression , Logistic regression	6
7.	Ensemble Learning	Bagging & Boosting, Random Forest, Adaboost	5
		Total number of Lectures	**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance and Tut Performance (10), Quiz/ Mini- Project/Assignment (15))
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Arnold, T., Kane, M., & Lewis, B. W. (2019). A computational approach to statistical learning. CRC Press.
2.	James, G., Witten, D., Hastie, T., &Tibshirani, R. (2013). Statistical learning. In An Introduction to Statistical Learning (pp. 15-57). Springer, New York, NY.
3.	Gutierrez, D. D. (2015). Machine learning and data science: an introduction to statistical learning methods with R. Technics Publications.
4.	Lomax, R. G., &Hahs-Vaughn, D. L. (2013). An introduction to statistical concepts. Routledge.
5.	Grus, J. (2019). Data science from scratch: first principles with python. O'Reilly Media.
6.	Chatfield, C., & Xing, H. (2019). The analysis of time series: an introduction with R. CRC press.
7.	Afifi, A., May, S., Donatello, R., & Clark, V. A. (2019). Practical multivariate analysis. CRC Press.
8.	Zumel, N., & Mount, J. (2014). Practical data science with R. Manning Publications Co..
9.	Saltz, J. S., & Stanton, J. M. (2017). An introduction to data science. SAGE Publications.