RAJALAKSHMI ENGINEERING COLLEGE
CURRICULUM AND SYLLABUS

M.Tech (Data Science)

Vision

- To be a Department of Excellence in Information Technology Education, Research and Development.

Mission

- To train the students to become highly knowledgeable in the field of Information Technology.
- To promote continuous learning and research in core and emerging areas.
- To develop globally competent students with strong foundations, who will be able to adapt to changing technologies.

PROGRAMME OUTCOMES (POs)

PO1: Graduates should be able to learn how to interpret data, extracts meaningful information, and assesses findings.

PO2: Graduates should capable of demonstrating and developing a design of mastery over the key technologies in data science and business analytics such as structured/unstructured data mining, machine learning, visualization techniques, predictive modeling and statistics.

PO3: Graduates should be capable of applying ethical principles and responsibilities during Professional practice.

PO4: Graduates should be able to function effectively as a team member and to write/ present a substantial technical report / document.

PO5: Graduates should independently carry out research / investigation and development work to solve industry and organization-specific problems and challenges using advanced analytics and computational methods.

PO6: Graduates should be able to engage in independent and life-long learning in the broadest context of technological change.

Curriculum 2023

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	MH23114	Mathematics for Data Science	FC	4	3	1	0	4
2.	PG23111	Research Methodology and IPR	MC	3	3	0	0	3
3.	DS23111	Machine Learning Techniques	PC	3	3	0	0	3
4	DS23112	Data Science Foundation	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	CP23131	Advanced Data Structures and Algorithms	PC	5	3	0	2	4
5.	DS23131	Data Analysis and Visualization	PC	5	3	0	2	4
NON-CREDIT COURSES								
6.	AC23111	English for Research Paper Writing	MC	3	3	0	0	0
Total				**26**	**21**	**1**	**4**	**21**

SEMESTER II

SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	DS23211	Programming for Data Science	PC	3	3	0	0	3
2.		Professional Elective - I	PE	3	3	0	0	3
3.		Professional Elective - II	PE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	DS23231	Big Data Analytics and Tools	PC	5	3	0	2	4
5.	DS23232	Cloud Computing Technologies	PC	5	3	0	2	4
NON-CREDIT COURSES								
6.	AC23211	Constitution of India	MC	3	3	0	0	0
LABORATORY COURSES								
7.	DS23221	Programming for Data Science Laboratory	PC	4	0	0	4	2
Total				**26**	**18**	**0**	**8**	**19**

SEMESTER III

SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	DS23311	Security for Data Science	PC	3	3	0	0	3
2.		Professional Elective - III	PE	3	3	0	0	3
3.		Professional Elective - IV	PE	3	3	0	0	3
4.		Open Elective - I	OE	3	3	0	0	3
LABORATORY COURSES								
6.	DS23321	Project Phase - I	EEC	12	12	0	12	6
		Total		**24**	**12**	**0**	**12**	**18**

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SEMESTER IV

SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
1.	DS23421	Project Phase - II	EEC	12	0	0	24	12
		Total		**12**	**0**	**0**	**24**	**12**

	PROGRAM ELECTIVES (PE)							
S.No	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
Emerging Technologies								
1.	DS23A11	AI for Computer Vision	PE	3	3	0	0	3
2.	DS2A12	Deep Learning Techniques	PE	3	3	0	0	3
3.	DS23A13	Natural Language Processing and Application	PE	3	3	0	0	3
4.	DS23A14	Industrial Internet of Things	PE	3	3	0	0	3
5.	DS23A15	AI-Powered Chat Bots	PE	3	3	0	0	3
6.	DS23A16	Drone Technologies	PE	3	3	0	0	3
7.	DS23A17	Augmented Reality	PE	3	3	0	0	3
Business Analytics								
1.	DS23B11	Social Network Analysis and Visualization	PE	3	3	0	0	3
2.	DS23B12	Health Care Data Analytics	PE	3	3	0	0	3
3.	DS23B13	Applied Business Analytics	PE	3	3	0	0	3
4.	DS23B14	Supply Chain and Logistics Analytics	PE	3	3	0	0	3
5.	DS23B15	Marketing and Retail Analytics	PE	3	3	0	0	3
6.	DS23B16	Financial and Risk Analytics	PE	3	3	0	0	3
7.	DS23B17	Recommender Systems	PE	3	3	0	0	3
8.	CP23B14	Predictive Modelling	PE	3	3	0	0	3

OPEN ELECTIVE COURSES OFFERED BY IT

SL. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
1.	DS23O31	Python for Data Scence	OE	5	1	0	4	3

TOTAL CREDITS : 70

Credit Distribution

Category	R2023
Mathematical courses FC	4
Professional core courses PC	30
Professional Elective Courses PE	12
Open Electives from other technical and /or emerging subjects OE	3
Project work, seminar and internship in industry or elsewhere EEC	18
Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, The essence of Indian Knowledge Tradition] MC	3
Total	70

SUMMARY OF ALL COURSES

S.NO	Course Category	Credits per Semester				Total Credits
		1	2	3	4	
1.	FC	4				**4**
2.	PC	14	13	3		**30**
3.	PE		6	6		**12**
4.	OE			3		**3**
5.	EEC			6	12	**18**
6.	MC	3				**3**
	Total	**21**	**19**	**18**	**12**	**70**

Credit Distribution

Category	R2019	R2023
Mathematical courses FC / Basic Science BS	4	4
Professional core courses PC	31	30
Professional Elective Courses PE	13	12
Open Electives from other technical and /or emerging subjects OE	3	3
Project work, seminar and internship in industry or elsewhere EEC	18	18
Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, The essence of Indian Knowledge Tradition] MC	3	3
Total	72	70

Subject Code	Subject Name	Category	L	T	P	C
MH23114	MATHEMATICS FOR DATA SCIENCE	FC	3	1	0	4
Common to I sem. - M.Tech. Data Science						

Objectives:

- To List the ideal properties of different types of estimators and select the best estimators using different properties.
- To introduce the principles and characteristics of the multivariate data analysis techniques.
- To develop different discriminant functions and to examine certain difference amongst the different groups in terms of the prediction variables.
- To compare and contrast the factor analytic model with other measurement models.
- To provide Basic ideas and concepts of hierarchical and non-hierarchical cluster analysis.

UNIT-I	**ESTIMATION THEORY**	**12**
Unbiased Estimators – method of moments – maximum likelihood estimation - curve fitting by principle of least squares – regression lines.		
UNIT-II	**MULTIVARIATE ANALYSIS**	**12**
Random vectors and matrices - mean vectors and covariance matrices –multivariate normal density and its properties - population principal components- principle components from standardized variables.		
UNIT-III	**DISCRIMINANT ANALYSIS**	**12**
Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties		
UNIT-IV	**FACTOR ANALYSIS**	**12**
Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.		
UNIT-V	**CLUSTER ANALYSIS**	**12**
Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters		
	Total Contact Hours: 60	

Course Outcomes:

On completion of the course, students will be able to

- Apply the concept of estimation theory and curve fitting for forecasting in engineering and technology.
- Carry out and apply commonly used multivariate data analysis techniques, and interpret results
- Develop different discriminant functions and to examine certain difference amongst the different groups in terms of the prediction variables.
- Describe the difference between exploratory factor analysis and principal components analysis.
- Discover the basic concepts of cluster analysis, and a set of typical clustering methodologies, algorithms, and applications.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):	
1.	Gupta S.C. and KapoorV.K."Fundamentals of Mathematical Statistics", Sultan and Sons.
2.	Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis",Pearson Education, Asia, Fifth Edition.
3.	T.W. Anderson."An Introduction to Multivariate Statistical Analysis". Wiley, Third edition, 2003.

Reference Books(s) / Web links:	
1.	Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Thomson and Duxbury.
2.	D.A. Belsey, E. Kuh and R.E. Welsch ,"Regression Diagnostics , Identifying Influential Data and Sources of Collinearety".
3.	M.R. Anderberg, "Cluster Analysis for Applications", Academic Press.

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
PG23111	Research Methodology and IPR	MC	3	0	0	3

Objectives:

- At the end of this course, the students will be able to understand the research problem formulation and analyse the research-related information by following research ethics.
- Inculcating the understanding of today's computer, and information technology and also understanding tomorrow's world of ideas and creativity.
- Emphasizing the role of IPR in individual and nation growth

UNIT-I	**INTRODUCTION TO RESEARCH METHODOLOGY**	9

Objectives and Motivation of Research - Types of Research - Defining and Formulating the Research Problem - Errors in selecting a research problem - Features of research design, Different Research Designs- Criteria of good research - Problems encountered by researchers in India - Benefits to society in general.

UNIT-II	**DATA ANALYSIS AND HYPOTHESIS TESTING**	9

Data collection: Primary data - Secondary data - Data organization - Sample design - Estimation of population - Parametric vs. non-parametric methods - Measures of central tendency and dispersion.
ANOVA; Principles of least squares-Regression and correlation; Normal Distribution Properties of Normal Distribution; Testing of Hypothesis – Hypothesis Testing Procedure, Types of errors, t-Distribution - Chi-Square Test as a Test of Goodness of Fit - Use of statistical software.

UNIT-III	**LITERATURE REVIEW AND RESEARCH REPORT WRITING**	9

Effective literature studies approach- Importance of literature survey - Sources of information– analysis – Plagiarism - Research ethics.
Interpretation and Report Writing - Techniques and Precautions; Report Writing – Significance - Different Steps – Layout - Types of reports, Mechanics of Writing a Research Report - Precautions in Writing Reports; Format of the research report

UNIT-IV	**INTRODUCTION TO INTELLECTUAL PROPERTY, TRADEMARKS, GRAPHICAL INDICATION AND INDUSTRIAL DESIGN**	9

Importance of intellectual property rights; types of intellectual property-international organizations; Purpose and function of trademarks - acquisition of trademark rights - protectable matter - selecting and evaluating trademark- trademark registration processes.
Industrial designs and IC Layout design - Registrations of designs-Semiconductor Integrated circuits and layout design Act - Geographical indications-potential benefits of Geographical Indications.

UNIT-V	**LAW OF COPYRIGHTS AND PATENTS**	9

Fundamental of copyright law - originality of material - rights of reproduction - rights to perform the work publicly - copyright ownership issues - copyright registration -notice of copyright, international copyright law.
Law of patents: Foundation of patent law, patent searching process - ownership rights and transfer New Developments in IPR: Administration of Patent System.

Total Contact Hours:	45

Course Outcomes:

- Understand the research problem and research process
- To formulate the hypothesis, data collection and processing, analyzing the data using statistical methods
- Interpret the observations and communicate the novel findings through a research report.
- Apply the conceptual knowledge of intellectual property rights for filing patents and trademark registration process.
- Understand adequate knowledge on copyright and patent law and rights..

REFERENCES:

1. C.R. Kothari, Research Methodology: Methods and Techniques, 2nd revised edition, New Age International Publishers, New Delhi, 2004.
2. Deborah, E. Bouchoux, Intellectual property right, 5th edition, Cengage learning, 2017.
3. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.
4. Prabuddha Ganguli, Intellectual property right - Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd, 2001.
5. Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000
6. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.
7. Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

CO-PO MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	2	1	2	2	3	2
C02	2	2	2	2	2	2
C03	1	1	1	1	2	2
C04	1	2	2	2	3	2
C05	1	1	1	2	2	2
Average	2	1	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23111	MACHINE LEARNING TECHNIQUES	PC	3	0	0	3

Objectives:	
●	To understand the machine learning theory
●	To implement linear and non-linear learning models
●	To implement distance-based clustering techniques
●	To build tree and rule based models
●	To apply reinforcement learning techniques

UNIT I	FOUNDATIONS OF LEARNING	9
Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve		
UNIT II	**LINEAR MODELS**	**9**
Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation		
UNIT III	**DISTANCE-BASED MODELS**	**9**
Nearest neighbor models – K-means – clustering around medoids – silhouettes – hierarchical clustering – k-d trees – locality sensitive hashing – non-parametric regression – ensemble learning– bagging and random forests – boosting – meta learning		
UNIT IV	**TREE AND RULE MODELS**	**9**
Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning		
UNIT V	**REINFORCEMENT LEARNING**	**9**
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control		
	Total Contact Hours : 45	

Course Outcomes: On completion of course students will be able to	
●	To explain theory underlying machine learning
●	To construct algorithms to learn linear and non-linear models
●	To implement data clustering algorithms
●	To construct algorithms to learn tree and rule-based models
●	To apply reinforcement learning techniques

Reference Books(s) / Web links:	
1	Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”,AMLBook Publishers, 2012.
2	P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3	K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
4	C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007
5	D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.
6	M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
7	T. M. Mitchell, “Machine Learning”, McGraw Hill, 1997.
8	S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Prentice Hall, 2009.

CO-PO MAPPING

PO CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	2	-	2	-	1
C02	3	2	-	2	-	2
C03	2	2	1	2	-	1
C04	1	1	1	2	2	2
C05	1	1	-	2	2	1
Average	2	1.6	1	2	2	1.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23112	**Data Science Foundation**	PC	3	0	0	3

Objectives:	
●	Provide you with the knowledge and expertise to become a proficient data scientist.
●	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
●	Produce Python code to statistically analyse a dataset
●	Critically evaluate data visualisations based on their design and use for communicating stories from data
●	To understand the application and recent trends in Data Science process

UNIT I	**INTRODUCTION**	**IN**
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.		
UNIT II	**DATA COLLECTION AND MANAGEMEMNT**	**9**
Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources		
UNIT III	**DATA ANALYSIS**	**9**
Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.		
UNIT IV	**DATA VISUALISATION**	**9**
Introduction, Types of data visualisation, Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.		
UNIT V	**APPLICATIONS**	**9**
Applications of Data Science, Technologies for visualisation, Bokeh (Python). Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science		
	Total Contact Hours : 45	

Course Outcomes: **On completion of course students will be able to**	
●	Explain how data is collected, managed and stored for data science
●	Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists
●	Implement data collection and management scripts using MongoDB
●	To understand the concepts of data visualization
●	To understand the application and recent trends in Data Science process

Reference Books(s) / Web links:	
1	Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data",AMLBook Publishers, 2012.
2	P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
3	K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
4	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007
5	D. Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012.
6	M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
7	T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.
8	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.

References:

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

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

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CP23131	ADVANCED DATA STRUCTURES AND ALGORITHMS	PC	3	0	2	4

Objectives:	
•	To understand the usage of algorithms in computing.
•	To learn and use hierarchical data structures and its operations.
•	To learn the usage of graphs and its applications.
•	To select and design data structures and algorithms that is appropriate for problems.
•	To study about NP Completeness of problems.

UNIT-I	ROLE OF ALGORITHMS IN COMPUTING	9
Algorithms –Introduction: Classical Algorithms–Analyzing Algorithms – Designing Algorithms– Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions– Solving Recurrences: The Substitution Method – Master theorem method– The Recursion–Tree Method.		
UNIT-II	**HIERARCHICAL DATA STRUCTURES**	**9**
Binary Search Trees: Basics –Insertion, Deletion and Search– Red-Black Trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion –B-Trees: Definition– Basic operations on B-Trees – Deleting a key from a B-Tree– Fibonacci Heaps: structure – Merge able-heap operations– Decreasing a key and deleting a Node–Bounding the maximum degree.		
UNIT-III	**GRAPHS**	**9**
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components– Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim– Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd, Warshall Algorithm, Johnson's algorithm for sparse graphs.		
UNIT-IV	**ALGORITHM DESIGN TECHNIQUES**	**9**
Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming –Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy– Huffman Codes.		
UNIT-V	**NP COMPLETE AND NP HARD**	**9**
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems		
	Contact Hours : 45	

List of Experiments				
1	Implementation of graph search algorithms.			
2	Implementation and application of network flow and linear programming problems.			
3	Implementation of algorithms using dynamic programming techniques.			
4	Implementation of recursive backtracking algorithms.			
5	Implementation of randomized algorithms.			
6	Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues and concurrent stacks.			
7	Developing applications involving concurrency.			
	Contact Hours	**:**	**45**	
	Total Contact Hours	**:**	**90**	

Platform Needed:	
HARDWARE :	Personal Computer with Dual Core Processor with 4 GB RAM.
SOFTWARE :	C/C++/Java Compilers

Course Outcomes: On completion of the course, the students will be able to	
•	Design data structures and algorithms to solve computing problems.
•	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
•	Understand the importance of Graphs and its applications.
•	Apply suitable design strategy for problem solving.
•	Differentiate NP complete and NP hard.

Reference Books(s):	
1	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006.
2	Robert Sedgewick and Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education.
3	S. Sridhar, "Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014
4	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, Prentice-Hall, 2011.

CO - PO matrices of course

P O / CO	PO1	PO2	PO3	PO4	PO5
CP19101.1	3	-	1	2	-
CP19101.2	2	-	1	1	1
CP19101.3	3	-	2	1	-
CP19101.4	2	-	1	2	1
CP19101.5	2	-	2	1	1
AVERAGE	2	-	1	1	1

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23131	DATA ANALYSIS AND VISUALIZATION	PC	3	0	2	4

Objectives:	
●	To parse a real-world data analysis problem into one or more computational components learned in this course,
●	To apply suitable machine learning and/or visualization techniques and analyse the results obtained to enable optimal decision making.
●	To understand regression and classification algorithms.
●	To learn data visualization techniques.

UNIT I	INTRODUCTION TO DATA ANALYTICS	9
Importance of analytics and visualization in the era of data abundance- -Review of probability, statistics and random processes-- Brief introduction to estimation theory		
UNIT II	**MACHINE LEARNING TECHNIQUES**	**9**
Introduction to machine learning, supervised and unsupervised learning, gradient descent, overfitting, regularization etc. – Clustering techniques: K-means, Gaussian mixture models and expectation-maximization, agglomerative clustering, evaluation of clustering - Rand index, mutual information based scores, Fowlkes-Mallows index etc.		
UNIT III	**REGRESSION AND CLASSIFICATION**	**9**
Regression: Linear models, ordinary least squares, ridge regression, LASSO, Gaussian Processes regression. - Supervised classification methods: K-nearest neighbor, naive Bayes, logistic regression, decision tree, support vector machine. - Sparse coding and dictionary learning, orthogonal matching pursuit.- Introduction to artificial neural networks (ANNs), deep NNs, convolutional neural network (CNN), and other recent topics.		
UNIT IV	**DATA VISUALIZATION**	**9**
Data visualization: Basic principles, categorical and continuous variables. - Exploratory graphical analysis. - Creating static graphs, animated visualizations - loops, GIFs and Videos.		
UNIT V	**DATA VISUALIZATION TOOLS**	**9**
Data visualization in Python and R, examples from Bokeh, Altair, ggPlot, ggplot2, gganimate, ImageMagick etc. - Introduction to Visualization Toolkit (VTK) for 3D computer graphics, image processing and visualization. - Visualization for deep learning.		
	Total Contact Hours : 45	

Course Outcomes: On completion of course students will be able to	
●	Parse a real-world data analysis problem into one or more computational components learned in this course,
●	Apply suitable machine learning and/or visualization techniques and analyze the results obtained to enable optimal decision making.
●	Understand regression and classification algorithms.
●	Apply data visualization techniques.
●	Use Data visualization tools

Reference Books(s) / Web links:	
1	Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie, The Elements of Statistical Learning, Springer, 2001.
2	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3	David G. Stork, Peter E. Hart, and Richard O. Duda, Pattern Classification (2nd edition), Wiley, 2000.
4	. Edward Tufte, The Visual Display of Quantitative Information (2nd edition), Graphics Press, 2001.
5	Colin Ware, Information Visualization: Perception for Design (2nd edition), Morgan Kaufmann, 2004.
6	Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, Pearson Education, 2013.
7	Nathan Yau, Data Points: Visualization That Means Something, Wiley, 2013.
8	Charles D. Hansen and Chris R. Johnson, Visualization Handbook, Academic Press, 2004.
9	Will Schroeder, Ken Martin, and Bill Lorensen, The Visualization Toolkit: An Object-Oriented Approach to 3D Graphics, Kitware Inc. Publishers, 2004.

List of Experiments				
1.	Analytics Tools And Techniques With Python Python: Data Manipulation, Data Exploration & Data Preparation, Modelling With Python			
2.	Statistical Analysis			
3.	Advanced Analytics And Machine Learning Linear Regression Logistic Regression Cluster Analysis Decision Trees And Resampling Techniques Ensemble Models, Boosting And Random Forest			
4.	Complex Techniques In Statistics And ML Time Series PCA And SVM Text Mining And NLP			
5.	Data Visualization Tools Python tools to visualize the result			
6.	Deep Learning Techniques And Tools			
7.	Real Time Case Studies Using ML in Python			
		Contact Hours	**:**	**45**
		Total Hours	**:**	**90**

CO-PO MAPPING

PO CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	-	2	3	2
C02	3	3	-	2	3	2
C03	3	3	-	2	3	2
C04	3	3	-	2	3	2
C05	3	3	-	2	3	2
Average	3	3	-	2	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Subject Code	Subject Name	Category	L	T	P	C
AC23111	English for Research Paper Writing Common to all branches of M.E. /M.Tech – I Semester		3	0	0	0

Objectives:	
●	To facilitate the students to express technical ideas in writing
●	To train the students in using language structures appropriately
●	To enable students to plan and organize the research paper
●	To assist the students in understanding the structure and familiarise the mechanics of organised writing
●	To equip the students to improvise academic English and acquire research writing skills

UNIT-I	INTRODUCTION TO RESEARCH WRITING	9
Research – Types of Research - Selecting the Primary resources - Categorizing secondary sources - Discovering a researchable area and topic – Need Analysis - Research Question- Focussing on the Research Problem- Developing Research Design – Framing the Hypothesis – Identifying the Scope of the Research - Writing – General and Academic Writing		
UNIT-II	**LANGUAGE OF WRITING**	9
Active reading – text mining – use of academic words – jargons – ambiguities – use of expression – use of tense - proper voices – third person narration – phraseology – use of foreign words – useof quotes – interpreting quotes.		
UNIT-III	**THE FORMAT OF WRITING**	9
Types of Journals - different formats and styles - IEEE format - Structure – Margins - TextFormatting - Heading and Title - Running Head with Page Numbers - Tables and illustrations - Paper and Printing - Paragraphs - Highlighting – Quotation – Footnotes		
UNIT-IV	**ORGANISING A RESEARCH PAPER**	9
Title- Abstract – Introduction – Literature review - Methodology - Results –Discussion –Conclusion - Appendices - Summarising - Citation and Bibliography		
UNIT-V	**PUBLISHING PAPER**	9
Finding the Prospective publication or Journal - analysing the credits - Reviewing - Revising –Plagiarism Check - Proofreading - Preparing the Manuscript- Submitting - Resubmitting - Follow up - Publishing		
	Total ContactHours	45

Course Outcomes:
On completion of the course, students will be able to

- Understand the basic structure of research work
- Apply proper use of language in writing paper
- Comprehend different formats of journal paper
- Follow the process of writing a research paper and write one
- Emulate the process of publishing journal paper and publish papers

SUGGESTED ACTIVITIES

- Group Discussions
- Writing review of literature
- Presentations
- Case study
- Writing a paper

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

REFERENCES	
1	Adrian Wallwork: "English for Writing Research Papers", Springer Science Business Media,Second Edition, LLC 2011
2	Stephen Howe and Kristina Henrikssion: "Phrasebook for Writing Papers and Research in English", The Whole World Company Press, Cambridge, Fourth edition 2007
3	The Modern Language Association of America: "MLA Handbook for Writers of ResearchPapers" 8th Edition, The Modern Language Association of America, 2016
4	Rowena Murray: The Handbook of Academic Writing: A Fresh Approach, Sarah Moore Open University Press, 2006
5	Stephen Bailey: Academic Writing: A Practical Guide for Students Routledge Falmer: 2003
6	Joseph M. Moxley: Publish, Don't Perish: The Scholar's Guide to Academic Writing andPublishing, Praeger Publishers, 1992

CO-PO MAPPING

PO **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
C01	-	1	-	-	3	3
C02	-	-	-	-	3	1
C03	-	2	-	-	3	3
C04	-	1	-	-	2	3
C05	-	1	-	-	3	2
Average	0	1.25	0	0	2.8	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name	Category	L	T	P	C
AC23111	English for Research Writing For I Semester M.E/M.TECH		3	0	0	0

Objectives:	
●	To facilitate the students to express technical ideas in writing
●	To train the students in using language structures appropriately
●	To enable students to plan and organize the research paper
●	To assist the students in understanding the structure and familiarise the mechanics of organised writing
●	To equip the students to improvise academic English and acquire research writing skills

UNIT-I	INTRODUCTION TO RESEARCH WRITING	9
Research – Types of Research - Selecting the Primary resources - Categorizing secondary sources - Discovering a researchable area and topic – Need Analysis - Research Question - Focussing on the Research Problem- Developing Research Design – Framing the Hypothesis – Identifying the Scope of the Research - Writing – General and Academic Writing		
UNIT-II	**LANGUAGE OF WRITING**	**9**
Active reading – text mining – use of academic words – jargons – ambiguities – use of expression – use of tense - proper voices – third person narration – phraseology – use of foreign words – use of quotes – interpreting quotes.		
UNIT-III	**THE FORMAT OF WRITING**	**9**
Types of Journals - different formats and styles - IEEE format - Structure – Margins - Text Formatting - Heading and Title - Running Head with Page Numbers - Tables and illustrations - Paper and Printing - Paragraphs - Highlighting – Quotation – Footnotes		
UNIT-IV	**ORGANISING A RESEARCH PAPER**	**9**
Title- Abstract – Introduction – Literature review - Methodology - Results –Discussion –Conclusion - Appendices - Summarising - Citation and Bibliography		
UNIT-V	**PUBLISHING PAPER**	**9**
Finding the Prospective publication or Journal - analysing the credits - Reviewing - Revising – Plagiarism Check - Proofreading - Preparing the Manuscript- Submitting - Resubmitting - Follow up - Publishing		
	Total Contact Hours : 45	

Course Outcomes: At the end of the course the learner will be able to:	
●	Understand the basic structure of research work
●	Apply proper use of language in writing paper
●	Comprehend different formats of journal paper
●	Follow the process of writing a research paper and write one
●	Emulate the process of publishing journal paper and publish papers

SUGGESTED ACTIVITIES

- Group Discussions
- Writing review of literature
- Presentations
- Case study
- Writing a paper

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

References	
1	Adrian Wallwork: “English for Writing Research Papers”, Springer Science Business Media, Second Edition, LLC 2011
2	Stephen Howe and Kristina Henrikssion: “Phrasebook for Writing Papers and Research in English”, The Whole World Company Press, Cambridge, Fourth edition 2007
3	The Modern Language Association of America: “MLA Handbook for Writers of Research Papers” 8th Edition, The Modern Language Association of America, 2016
4	Rowena Murray: The Handbook of Academic Writing: A Fresh Approach, Sarah Moore Open University Press, 2006
5	Stephen Bailey: Academic Writing: A Practical Guide for Students Routledge Falmer: 2003
6	Joseph M. Moxley: Publish, Don't Perish: The Scholar's Guide to Academic Writing and Publishing, Praeger Publishers, 1992

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23211	PROGRAMMING FOR DATA SCIENCE	PC	3	0	0	3

Objectives:	
●	To understand the basics of Data science.
●	To learn the basics of python programming.
●	To study the data structures provided by numpy library for arrays and Visualization using Python.
●	To learn the basics of R programming.
●	To learn and implement Data Science algorithms using R.

UNIT I	INTRODUCTION TO DATA SCIENCE	9
Data Science - Evolution of data – Best Practices for Big data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Application-Statistics for Analytics – Data science life cycle – Analysis and reporting –Modern Data Analytics Tools		
UNIT II	**INTRODUCTION TO PYTHON PROGRAMMING**	**9**
Basics of Python-Starting with python interpreter-Control flow statements-Functions-List,tuple,Dictionary-Lambda with mapper,reduce and filter-List and dictionary comprehension- Files- Modules –Packages - Regular expressions - Working with classes and Objects		
UNIT III	**DATA SCIENCE USING PYTHON**	**9**
Data Science Packages-Numpy,scipy, pandas-Building models and evalution with Scikit-Data Loading,Storage and File format- Data Wrangling: Clean, Transform, Merge, Reshape-Plotting and Visualization – Data Aggregation and Group Operations – Time Series - The Jupyter and PyDev development environments-Neural Network Basics - Data Exploration in Python - Statistical Methods for Evaluation using R - Visualization using Python - Building models and evalution with Scikit		
UNIT IV	**INTRODUCTION TO R**	**9**
Overview- DataTypes, Variables, Operators, Decision Making, Loops, Functions, Strings, Vector, List, Matrices, Arrays, Factors, Data Frames, Packages-Data Visualization – Data Interfaces- Reading and writing of CSV files-Exploratory Data Analysis using R-Statistical Methods for Evaluation using R		
UNIT V	**DATA SCIENCE USING R**	**9**
Association –Classification – Clustering – Time series Analysis-Text Analysis-–Prediction Algorithm-Image Analytics – Video Analytics – Data base analytics		
	Total Contact Hours : 45	

Course Outcomes:
On completion of course students will be able to

●	has experience in implementation/modification of methods involved in Data Science
●	Apply programming knowledge of python
●	manage data , analysis and problem solving
●	Gain knowledge in R Programming
●	Apply programming knowledge of R in Data Science

Reference Books(s) / Web links:	
1	Wes McKinney, "Python *for* Data Analysis", O'Reilly Media.2012
2	Sebastian Raschka, “Python Machine Learning”,Packpub.com,2015
3	https://www.datacamp.com/courses/statistical-thinking-in-python-part-1

CO-PO MAPPING

PO CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	1	1	2	2
C02	3	3	1	1	3	1
C03	3	3	1	1	3	1
C04	3	3	1	1	3	2
C05	3	3	1	1	3	2
Average	3	3	1	1	2.8	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name	Category	L	T	P	C
DS23231	BIG DATA ANALYTICS AND TOOLS	PC	3	0	2	4

Objectives:	
●	Understand big data for business intelligence
●	Learn business case studies for big data analytics
●	Understand nosql big data management
●	Perform map-reduce analytics using Hadoop and related tools

UNIT I	UNDERSTANDING BIG DATA	9
What is big data – why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – big data in medicine – advertising and big data – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics		
UNIT II	**NOSQL DATA MANAGEMENT**	**9**
Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – map reduce – partitioning and combining – composing map-reduce calculations		
UNIT III	**BASICS OF HADOOP**	**9**
Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes –design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow –Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures		
UNIT IV	**MAPREDUCE APPLICATIONS**	**9**
MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN –job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats		
UNIT V	**HADOOP RELATED TOOLS**	**9**
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Cassandra– cassandra data model – cassandra examples – cassandra clients – Hadoop integration- Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts-Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQLqueries.		
	Total Contact Hours : 45	

Course Outcomes: On completion of course students will be able to	
●	Describe big data and use cases from selected business domains
●	Explain NoSQL big data management
●	Install, configure, and run Hadoop and HDFS
●	Perform map-reduce analytics using Hadoop
●	Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
Reference Books(s) / Web links:	
1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3	Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
5	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012
6	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
7	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
8	Alan Gates, "Programming Pig", O'Reilley, 2011.

List of Experiments	
1.	(i).Perform setting up and Installing Hadoop in its two operating modes: · Pseudo distributed · Fully distributed. (ii).Use web based tools to monitor your Hadoop setup
2.	Implement the following file management tasks in Hadoop: • Adding files and directories • Retrieving files • Deleting files
3.	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. • Find the number of occurrence of each word appearing in the input file(s) • Performing a MapReduce Job for word search count (look for specific keywords in a file)
4.	Stop word elimination problem: Input: A large textual file containing one sentence per line . A small file containing a set of stop words (One stop word per line) Output: A textual file containing the same sentences of the large input file without the words appearing in the small file
5.	Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented. • Find average, max and min temperature for each year in NCDC data set? • Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.
6.	Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data
7.	Developing applications involving concurrency
8.	Write a Pig Latin scripts for finding TF-IDF value for book dataset
9	Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
10	Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scalar Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewedtogether.
11.	Write a single Spark application that: • Transposes the original Amazon food dataset, obtaining a PairRDD of the type • A Counts the frequencies of all the pairs of products reviewed together; • Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.
	Total Contact Hours : 40

	PO1	PO2	PO3	PO4	PO5	PO6
C01	1	1	1	1	2	2
C02	2	2	0	0	2	2
C03	2	2	0	0	1	1
C04	3	3	1	1	2	2
C05	3	3	1	1	3	3
Average	2.2	2.2	0.6	0.6	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23232	CLOUD COMPUTING TECHNOLOGIES	PC	3	0	2	4

Objectives:	
●	To introduce the broad perceptive of cloud architecture and model
●	To understand the concept of Virtualization
●	To be familiar with the lead players in the cloud
●	To understand the features of the cloud simulator
●	To apply different cloud programming models as per need

UNIT I	CLOUD ARCHITECTURE AND MODEL	9
Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, and SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.		
UNIT II	**VIRTUALIZATION**	**9**
Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization -Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices -Virtual Clusters and Resource Management – Virtualization for Data-centre Automation.		
UNIT III	**CLOUD INFRASTRUCTURE**	**9**
Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development– Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources		
UNIT IV	**PROGRAMMING MODEL**	**9**
Parallel and Distributed Programming Paradigms – Map Reduce, Twister and Iterative Map Reduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Aneka, Cloud Sim.		
UNIT V	**SECURITY IN THE CLOUD**	**9**
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security –Security Governance – Risk Management – Security Monitoring – Security Architecture Design –Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.		
	Total Contact Hours : 45	

Course Outcomes: On completion of course students will be able to	
●	Compare the strengths and limitations of cloud computing
●	Identify the architecture, infrastructure and delivery models of cloud computing
●	Apply suitable virtualization concept.
●	Choose the appropriate cloud player
●	Choose the appropriate Programming Models and approach.

Reference Books(s) / Web links:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4	Kumar Saurabh, "Cloud Computing – insights into New-Era Infrastructure", Wiley India, 2011.
5	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly
6	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7	Katarina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, "Grid and Cloud Computing – A Business Perspective on Technology and Applications", Springer

8	Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India, 2010.
9	RajkumarBuyya, Christian Vecchiola, S.TamaraiSelvi, 'Mastering Cloud Computing", TMGH, 2013.
10	Gautam Shroff, Enterprise Cloud Computing, Cambridge University Press, 2011
11	Michael Miller, Cloud Computing, Que Publishing,2008

List of Experiments				
1	Study of Cloud Computing & Architecture			
2	Virtualization in Cloud			
3	Study and implementation of Infrastructure as a Service			
4	Study and installation of Storage as a Service			
5	Implementation of identity management			
6	Write a program for web feed			
7	Study and implementation of Single-Sing-On			
8	Securing Servers in Cloud			
9	User Management in Cloud			
10	Case study on Amazon EC2			
11	Case study on Microsoft Azure			
12	Mini project			
		Total Contact Hours	**:**	**40**

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6
C01	1	1	0	0	1	1
C02	2	2	0	0	2	2
C03	3	3	0	0	3	3
C04	3	3	0	0	3	3
C05	3	3	0	0	3	3
Average	2.4	2.4	2.4	2.4	2.4	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
AC23211	CONSTITUTION OF INDIA Common to all branches of M.E. /M.Tech – II Semester		3	0	0	0

Objectives:	
●	To inculcate the values enshrined in the Indian constitution.
●	To create a sense of responsible and active citizenship
●	To make the students aware of the Constitutional and the Non- Constitutional bodies
●	To help the students understand the relationships exist between union and states
●	To make the students understand the sacrifices made by the freedom fighters.

UNIT-I	INTRODUCTION	9
Historical Background - Constituent Assembly of India - Philosophical foundations of the IndianConstitution - Features - Basic Structure – Preamble.		
UNIT-II	**UNION GOVERNMENT - EXECUTIVE, LEGISLATURE AND JUDICIARY**	9
Union and its territory - Citizenship - Fundamental Rights - Directive Principles of State Policy (DPSP) - Fundamental Duties. President - Vice President - Prime Minister - Central Council of Ministers - Cabinet Committees - Parliament: Committees, Forums and Groups - Supreme Court.		
UNIT-III	**STATE GOVERNMENT & UNION TERRITORIES: STATE GOVERNMENT : EXECUTIVE, LEGISLATURE AND JUDICIARY**	9
Governor - Chief Minister - State Council of Ministers - State Legislature - High Court - Subordinate Courts - Panchayati Raj – Municipalities-Union Territories - Scheduled and Tribal Areas.		
UNIT-IV	**RELATIONS BETWEEN UNION AND STATES**	9
Relations between Union and States - Services under Union and States. Cooperative Societies - Scheduled and Tribal Areas - Finance, Property, Contracts and Suits - Trade and Commerce withinIndian Territory – Tribunals.		
UNIT-V	**CONSTITUTIONAL BODIES AND AMENDMENTS**	9
Introduction to Constitutional & Non-Constitutional Bodies-Elections - Special Provisions relating to certain classes - Languages - Emergency Provisions - Miscellaneous - Amendment of the Constitution - Temporary, Transitional and Special Provisions - Short title, date of commencement, Authoritative text in Hindi and Repeals. Schedules of the Constitution of India - Appendices in the Constitution of India.		
	Total Contact Hours	45

Course Outcomes:
On completion of the course, students will be able to

- Appreciate the philosophical foundations of the Indian Constitution.
- Understand the functions of the Indian government.
- Apprehend and abide by the rules of the Indian constitution.
- Comprehend the functions of state Government and Local bodies.
- Gain Knowledge on constitution functions and role of constitutional bodies andamendments of constitution.

SUGGESTED ACTIVITIES

- Online Quizzes
- Poster presentations
- Presentations
- Group Discussions
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Books	
1	M Lakshmikanth "Indian Polity", McGraw Hill Education, 5th edition 2017.
2	Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21stedition, 2013.

Reference Books / Web links	
1	Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 7th edition, 2015.
2	Subhash Kashyap, "Our Constitution: An Introduction to India's Constitution andConstitutional Law", National Book Trust India, 1994.
3	Mahendra Prasad Singh and Himanshu Roy, "Indian Political System", Pearson India, 4th edition, 2017.

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
DS23221	PROGRAMMING FOR DATA SCIENCE LABORATORY	PC	0	0	4	2

Objectives:
• Learn the basics of Python Programming and Control statements
• Understand the concepts of Numpy, Pandas
• Understand the concept of basic statistics
• Learn the basics of Correlation and Regression Analysis
• Understand the concepts of Machine Learning Algorithms

Description of the Experiments	Total Contact Hours: 30
1. Working with Numpy arrays	
2. Working with Pandas data frames	
3. Basic plots using Matplotlib	
4. Frequency distributions	
5 Summary of Statistics - mean, median, mode, standard deviation and variance	
6. Correlation and scatter plots	
7. Regression Analysis	
8. Implementation of Decision tree-based ID3 Algorithm	
9. Implementation of Naïve Bayesian classifier	
10. Implementation of k-Nearest Neighbour Algorithm	
11. Implementation of K-Means Clustering Algorithm	

Course Outcomes:
• Use the basics of Python Programming in problem solving and conditionals and loops.
• Apply Numpy, Pandas and SciPy for numerical and statistical data
• Understand to implement Correlation Analysis
• Implemented the Regression Analysis on real world data sets
• Implemented Machine Learning Algorithms

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
• Experiment based viva • Quizzes • Mind map • Mini Projects

Web links for virtual lab (if any)
• https://www.python.org/shell/
• https://python-iitk.vlabs.ac.in/
• https://www.hackerrank.com/domains/python