

ACADEMIC CURRICULA

POSTGRADUATE DEGREE PROGRAMMES

Master of Technology in Big Data Analytics

Two Years(Full Time)

Learning Outcome Based Education

Choice Based Flexible Credit System

Academic Year

2020 - 2021



**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)**

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

M.Tech in Information Technology

Big Data Analytics

1. Department Vision Statement

Stmt - 1	To develop the skills and knowledge to excel in their professional career in Information Technology and related disciplines.
Stmt - 2	To contribute and communicate effectively with the team to grow into leader.
Stmt - 3	To practice lifelong learning for continuing professional development.

2. Department Mission Statement

Stmt - 1	To develop the ability to use and apply current technical concepts, skills, tools and practices in the core information technology areas.
Stmt - 2	To develop the ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based system.
Stmt - 3	To develop the ability to effectively integrate IT-based solutions into the user environment.

3. Program Education Objectives (PEO)

PEO - 1	Graduates involve in qualitative as well as quantitative techniques to improve business productivity and profits.
PEO - 2	Graduates will analyze the data efficiently with the current data analytics tools used by researchers, analysts, and engineers for business organizations.
PEO - 3	Graduates will practice lifelong learning for continuing professional development.
PEO - 4	Graduates exploit the power of big data analytics those are in high demand as organizations are looking for.

4. Consistency of PEO's with Mission of the Department

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	H	H	H	H	H
PEO - 2	H	H	H	H	H
PEO - 3	H	H	M	H	H
PEO - 4	H	H	M	H	H
PEO - 5	H	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

5. Consistency of PEO's with Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)														
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
PEO - 1	H	H	H	H	M	M	M	H	M	M	M	L	H	M	M
PEO - 2	H	H	H	H	M	M	M	H	M	M	M	L	H	M	M
PEO - 3	M	L	M	M	H	L	M	H	H	M	M	L	M	L	H
PEO - 4	H	H	H	H	M	H	M	H	H	H	H	H	H	H	H

H – High Correlation, M – Medium Correlation, L – Low Correlation

6. Programme Structure (70 Total Credits)

Professional Core Courses (C) (4 Courses)					Open Elective Courses (O) (Any 1 Course)						
Course Code	Course Title	Hours/Week			C	Course Code	Course Title	Hours/Week			C
		L	T	P				L	T	P	
20ITC501J	Multivariate techniques for data analytics	3	0	2	4	20MBO601T	Business Analytics	3	0	0	3
20ITC502J	Computing for data analytics	3	0	2	4	20MEO601T	Industrial Safety	3	0	0	3
20ITC503J	Big Data Technology	3	0	2	4	20MAO501T	Operations Research	3	0	0	3
20ITC504J	Machine Learning for data analytics	3	0	2	4	20MBO602T	Cost Management	3	0	0	3
Total Learning Credits					16	20NTO601T	Composite Materials	3	0	0	3
						20CEO531T	Waste to Energy	3	0	0	3
						20GNO620T	MOOC	-	-	-	3
						Total Learning Credits					3
Professional Elective Courses (E) (5 Courses)					Project Work, Internship In Industry / Higher Technical Institutions(P)						
Course Code	Course Title	Hours/Week			C	Course Code	Course Title	Hours/Week			C
		L	T	P				L	T	P	
20ITE505J	Cloud Computing for data analytics	3	0	2	4	20ITP601L	Internship (4-6 weeks during 2 nd sem vacation)	-	-	-	4
20ITE506J	Advanced Algorithms Analysis					20ITP602L	Minor Project	0	0	8	
20ITE507J	Python Programming for Data Analytics	3	0	2	4	20ITP603L	Project Work Phase I	0	0	12	6
20ITE508J	Functional Programming for data analytics	3	0	2	4	20ITP604L	Project Work Phase II	0	0	32	16
20ITE509J	Marketing Analytics	3	0	2	4	Total Learning Credits					26
20ITE514T	Risk Analytics	3	1	0	4						
20ITE510J	Applied Social Network Analysis	3	0	2	4	Audit Courses (A) (Any 2 Courses)					
20ITE511J	Natural Language processing techniques	3	0	2	4	Course Code	Course Title	Hours/Week			C
20ITE611J	Streaming Analytics	3	0	2	4	20CEA531J	Disaster Management	1	0	1	0
20ITE612J	Deep Learning for data analytics	3	0	2	4	20GNA511T	Constitution of India	1	0	1	0
Total Learning Credits					20	20GNA513J	Value Education	1	0	1	0
						20GNA512L	Physical and Mental Health using Yoga	1	0	1	0
						Mandatory Courses (M) (3 Courses)					
Course Code	Course Title	Hours/Week			C	Course Code	Course Title	Hours/Week			C
		L	T	P				L	T	P	
20GNS501J	Research Publishing and Presenting Skills	1	0	2	2	20PDM501T	Career Advancement Course for Engineers – I	1	0	1	0
20CSS503J	Research Methods in Computer Sciences	2	0	2	3	20PDM502T	Career Advancement Course for Engineers – II	1	0	1	0
Total Learning Credits					5	20PDM601T	Career Advancement Course for Engineers – III	1	0	1	0

Replace as appropriate i.e., Research Methods in Electrical Sciences / Mechanical Sciences etc.,

8. Program Articulation Matrix

Semester - I					Semester - II						
Code	Course Title	Hours/Week			C	Code	Course Title	Hours/Week			C
		L	T	P				L	T	P	
20ITC501J	Multivariate techniques for data analytics	3	0	2	4	20ITC503J	Big Data Technology	3	0	2	4
20ITC502J	Computing for data analytics	3	0	2	4	20ITC504J	Machine Learning for data analytics	3	0	2	4
20ITE505J	Cloud Computing for data analytics	3	0	2	4	20ITE509J	Marketing Analytics	3	0	2	4
20ITE506J	Advanced Algorithms Analysis					20ITE514T	Risk Analytics	3	1	0	4
20ITE507J	Python Programming for Data Analytics	3	0	2	4	20ITE510J	Applied Social Network Analysis				
20ITE508J	Functional Programming for data analytics					20ITE511J	Natural Language processing techniques	3	0	2	4
20GNS501J	Research Publishing and Presenting Skills	1	0	2	2	20CSS503J	Research Methods in Computer Sciences	2	0	2	3
20PDM501T	Career Advancement Course for Engineers – I	1	0	1	0	20PDM502T	Career Advancement Course for Engineers – II	1	0	1	0
	Audit Course - I	1	0	1	0		Audit Course - II	1	0	1	0
Total Learning Credits					18	Total Learning Credits					19
Semester - III					Semester - IV						
Code	Course Title	Hours/Week			C	Code	Course Title	Hours/Week			C
		L	T	P				L	T	P	
20ITE611J	Streaming Analytics	3	0	2	4	20ITP604L	Project Work Phase II	0	0	32	16
20ITE612J	Deep Learning for data analytics					Total Learning Credits					16
	Open Elective	3	0	0	3						
20GNO620T	MOOC	-	-	-							
20ITP601L	Internship (4-6 weeks during 2ndSem vacation)	-	-	-	4						
20ITP602L	Minor Project	0	0	8							
20ITP603L	Project Work Phase I	0	0	12	6						
20PDM601T	Career Advancement Course for Engineers – III	1	0	1	0						
Total Learning Credits					17						

H – High Correlation, M – Medium Correlation, L – Low Correlation

8. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
20ITC501J	Multivariate techniques for data analytics	H	H	H	H	M	-	L	-	-	-	-	-	-	-	M
20ITC502J	Computing for data analytics	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
20ITC503J	Big Data Technology	M	H	M	M	H	-	-	-	M	L	-	H	-	-	-
20ITC504J	Machine Learning for data analytics	H	H	H	H	H	-	H	-	H	-	-	-	-	-	L
20ITE505J	Cloud Computing for data analytics	M	H	L	M	M	-	-	-	M	L	-	H	-	-	M
20ITE506J	Advanced Algorithms Analysis	H	H	H	H	M	-	-	M	-	-	-	-	-	-	H
20ITE507J	Python Programming for Data Analytics	H	H	H	M	M	-	-	-	M	L	-	-	-	-	M
20ITE508J	Functional Programming for data analytics	H	H	H	M	M	-	-	-	M	L	-	-	-	-	M
20ITE509J	Marketing Analytics	H	M	H	H	M	H	-	M	-	H	M	M	-	M	M
20ITE514J	Risk Analytics	H	M	H	H	M	H	-	M	-	H	M	M	-	M	M
20ITE510J	Applied Social Network Analysis	H	H	M	H	M	-	M	H	M	-	-	H	-	-	H
20ITE511J	Natural Language processing techniques	H	M	M	H	H	-	M	H	M	-	-	-	-	-	H
20ITE611J	Streaming Analytics	H	H	M	H	M	-	M	M	H	M	-	-	H	-	H
20ITE612J	Deep Learning for data analytics	M	H	M	H	H	-	-	-	M	L	-	H	-	-	H
20GNS501J	Research Publishing and Presenting Skills															
20CSS503J	Research Methods in Computer Sciences															
20MBO601T	Business Analytics															
20MEO601T	Industrial Safety															
20MAO501T	Operations Research															
20MBO602T	Cost Management															
20NTO601T	Composite Materials															
20CEO531T	Waste to Energy															
20CEP620T	MOOC															
20ITP601L	Internship (4-6 weeks during 2 nd sem vacation)															
20ITP602L	Minor Project															
20ITP603L	Project Work Phase I	H	H	H	H	H	-	H	H	H	-	-	-	-	-	H
20ITP604L	Project Work Phase II	H	H	H	H	H	-	H	H	H	-	-	-	-	-	H
20CEA531J	Disaster Management															
20GNA511T	Constitution of India															
20GNA513J	Value Education															
20GNA512L	Physical and Mental Health using Yoga															
20PDM501T	Career Advancement Course for Engineers – I	L	H	H	H		H			H					H	H
20PDM502T	Career Advancement Course for Engineers – II	L	H	H	H		H			H					H	H
20PDM601T	Career Advancement Course for Engineers – III	L	H	H	H		H			H		H	M	H	H	H
	Program Average															

Course Code	20ITC501J	Course Name	MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS	Course Category	C	Professional Core										L	T	P	C					
						3	0	2	4															
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses																		
Course Offering Department	Information Technology			Data Book / Codes/Standards	Nil																			
Course Learning Rationale (CLR):	The purpose of learning this course is to:				Learning			Program Learning Outcomes (PLO)																
CLR-1 :	Utilize data characteristics in form of distribution of the data structures				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
CLR-2 :	Utilize the statistical data reduction techniques				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning		
CLR-3 :	Understand the usage of multivariate techniques for the problem under the consideration.																							
CLR-4 :	Draw valid inferences and to plan for future investigations																							
CLR-5 :	Optimize objectives and get most select results																							
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Understand the characteristics of data and its properties				1	80	75	H	M	H	H	M	-	-	-	-	-	-	-	-	-	-	M	
CLO-2 :	Effectively select and use the data reduction techniques				1	75	75	H	H	H	H	H	-	M	-	-	-	-	-	-	-	-	-	M
CLO-3 :	Deploy the multivariate techniques to solve the real world problems				2	80	75	H	H	M	M	M	-	M	-	-	-	-	-	-	-	-	-	H
CLO-4 :	Acquire information and inferences from data to predict future output				2	75	70	H	H	M	M	M	-	-	-	-	-	-	-	-	-	-	-	H
CLO-5 :	Achieve optimal solutions that maximize returns				3	80	80	H	M	H	H	M	-	-	-	-	-	-	-	-	-	-	-	M

Duration (hour)	15	15	15	15	15	
S-1	SLO-1 SLO-2	Meaning of Multivariate Analysis	Factor Analysis Introduction	Cluster Analysis Introduction	Discriminant Analysis Introduction and Purpose with examples	Linear Programming problem Introduction
S-2	SLO-1 SLO-2	Measurements Scales	Meanings, Objectives	Objectives and Assumptions	Discriminant Analysis concept, objective	Linear Programming problem Applications
S-3	SLO-1 SLO-2	Metric measurement scales and Non-metric measurement scales	Assumptions	Research design in cluster analysis	Discriminant Analysis applications	Formulation of LPP
S-4-5	SLO-1 SLO-2	Lab 1: Exploration of data sets and characteristics in R	Lab4 :Implementation of factor analysis in R	Lab 7 :Implementation of cluster analysis in R	Lab10: Implementation of discriminant analysis in R	Lab 13: Formulating a LPP in R from a data set

S-6	SLO-1		<i>Designing a factor analysis</i>	<i>Deriving clusters</i>		<i>Graphical method</i>
	SLO-2	<i>Classification of multivariate techniques</i>			<i>Procedure for conducting discriminant analysis</i>	
S-7	SLO-1	<i>Dependence Techniques</i>	<i>Designing a factor analysis - Example</i>	<i>assessing overall fit</i>	<i>Procedure for conducting discriminant analysis - Demo</i>	<i>Simplex method</i>
	SLO-2					
S-8	SLO-1	<i>Inter-dependence Techniques</i>	<i>Designing a factor analysis – Demo</i>	<i>Deriving clusters – Demo and examples</i>	<i>Procedure for conducting discriminant analysis - Examples</i>	<i>Graphical and simplex methods – Problems, examples and demo</i>
	SLO-2					
S-9-10	SLO-1	<i>Lab 2: Implementation of dependent and inter dependence techniques</i>	<i>Lab 5: Implementation of factor analysis in R</i>	<i>Lab 8: Implementation of cluster analysis in R</i>	<i>Lab 11: Implementation of discriminant analysis in R</i>	<i>Lab 14: Solving LPP in R – Graphical and Simplex</i>
	SLO-2					
S-11	SLO-1	<i>Applications of multivariate techniques</i>	<i>Deriving factors and assessing overall factors</i>	<i>Hierarchical methods</i>	<i>Stepwise discriminate analysis</i>	<i>Integer Programming</i>
	SLO-2					
S-12	SLO-1	<i>Applications of multivariate techniques -Examples</i>	<i>Interpreting the factors and validation of factor analysis</i>	<i>Non Hierarchical Methods</i>	<i>Mahalanobis procedure</i>	<i>Transportation problem</i>
	SLO-2					
S-13	SLO-1	<i>Applications of multivariate techniques - Demo</i>	<i>Interpreting the factors and validation of factor analysis – Demo and Examples</i>	<i>Combinations</i>	<i>Logit model</i>	<i>Assignment problem</i>
	SLO-2					
S-14-15	SLO-1	<i>Lab 3: Explore scope of multivariate analytics in different applications</i>	<i>Lab 6: Interpreting factor analysis</i>	<i>Lab9: Implementation of cluster analysis in R</i>	<i>Lab 12: Implementation of discriminant analysis in R</i>	<i>Lab 15 :Implementation of transportation of assignment problem in R</i>
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013. 2. T. W. Anderson , “An Introduction to Multivariate Statistical Analysis, 3rd Edition”, Wiley, 2003. 3. William r Dillon, John Wiley & sons, “Multivariate Analysis methods and applications”, Wiley, 1984. 	<ol style="list-style-type: none"> 4. Naresh K Malhotra, Satyabhusan Dash, “Marketing Research Anapplied Orientation”, Pearson, 2011. 5. Hamdy A Taha, “Operations Research”, Pearson, 2012. 6. S R Yaday, A K Malik, “Operations Research”, Oxford, 2014.
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Hari Sekharan ,Freelance Software consultancy on Big data, analytics	1. <i>Dr.JeyaShree, Professor, Rajalakshmi Institute of Technology</i>	1. <i>Ms. K. Sornalakshmi, SRMIST</i>
		2. <i>Ms.D.Hemavathi SRMIST</i>

Course Code	20ITC502J	Course Name	COMPUTING FOR DATA ANALYTICS			Course Category	C	Professional Core				L	T	P	C
												3	0	2	4
Pre-requisite Courses	Nil			Co-requisite Courses	Nil			Progressive Courses							
Course Offering Department	Information Technology			Data Book / Codes/Standards	Nil										

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Understanding the Role of Data Science Engineer, Big data analyst	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
CLR-2 :	Understanding the Role of Business Intelligence																		
CLR-3 :	Practicing the foundations of statistics required for Analytics																		
CLR-4 :	Practicing Interval estimation and understanding hypothesis testing strategy																		
CLR-5 :	Utilizing Supervised learning algorithms																		
CLR-6 :	Utilizing Unsupervised learning algorithms																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Identification of role of different professionals	1	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Applying visualization techniques	1	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Applying fundamental Statistics in different case studies	2	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Applying Interval estimation and hypothesis testing	2	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Applying various supervised techniques	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Applying various unsupervised techniques and ensemble techniques	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Overview of Data science - data engineering,	Descriptive Statistics: Data Summarization	Sampling distributions: Basic terminologies	Introduction to Machine Learning	Unsupervised learning - Clustering
	SLO-2				Supervised learning - Regression Analysis	K-means algorithm
S-2	SLO-1	Introduction to Data engineering - DB,ETL	Measure of Location, skewness and shape	Central limit theorem	True versus Fitted Regression Line, f1score, over fitting and under fitting	hierarchical and Dimensionality reduction
	SLO-2					
S-3	SLO-1	Introduction to Big data analytics, Data in Data analytics	Measure of dispersion- Range, Varaince	Applicability of Central limit theorem	Least Square method, Measure of quality of Fit	Principle component analysis (PCA)
	SLO-2		Standard Deviation		Potential problems in Linear regression	
S 4-5	SLO-1	Lab. 1: Role of data analyst in netflix application	Lab. 4: Understanding R- Data types	Lab.7: problems on Probability	Lab. 10: Implementation of Linear Regression in R	Lab. 13: Implementation of K-means algorithm
	SLO-2					
S-6	SLO-1	NOIR classification, State of the practice in analytics, role of data scientist	Mean absolute Deviation, Absolute Average variation	Chi squared Distribution Inferential Statistics : Approaches- Hypothesis, Confidence Interval measurement	Classification techniques - Logistic Regression : Introduction to classification , confusion matrix 2*2 and 3*3	Ensemble techniques - introduction to ensemble technique
	SLO-2					
S-7	SLO-1	Key roles for successful analytic project	Inter Quartile Range, Five Number summary	Hypothesis testing procedur	Gradient descent, Maximum likelihood Estimation	Bagging
	SLO-2		Other measures (Arithmetic, Geometric, Harmonic mean)			
S-8	SLO-1	Main phases of life cycle	Bivaraint - correlation Covariance	Errors in Hypothesis testing	Model evaluation metrics, Multiple Linear Regression	Bagging -Continued
	SLO-2		Introduction to Probability distribution: Discrete and continuous			

S 9-10	SLO-1	Lab. 2: Role of Big data analyst in Health care Domai	Lab. 5: Understanding Functions, Import, Export	Lab. 8: Problems on Hypothesis	Lab. 11: Implementation of Multiple Regression in R	Lab. 14: Implementation of Logistic Regression in R
	SLO-2					
S-11	SLO-1	overview about BI tool	Discrete : Binomial	Rejection region, Two tailed test, One tailed test	Naive Bayes' classifier, M-Estimate approach	Boosting
	SLO-2			Parametric Tests (Z-test, t-test)		
S-12	SLO-1	Application of BI and advantages of BI	Poisson	Parametric Tests (Chi square test, F-test)	Decision tree: Induction, Information Gain	Boosting-Continued
	SLO-2					
S-13	SLO-1	Developing core deliverables for stakeholders	Continuous : Normal, Exponential	Relationship analysis : Correlation analysis- Karl Pearson coefficient correlation	CART algorithm	Stacking
	SLO-2					
S 14-15	SLO-1	Lab 3: Role of Data Engineer Fraud management and Prevention	Lab.6: problems on Data Summarization	Lab.9: problems on Correlation	Lab. 12: Implementation of Logistic Regression in R	Lab. 15: Implementation of Logistic Regression in R
	SLO-2					

Learning Resources	1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., "Understanding Big Data", McGrawHill, 2012.	4. Gareth James, Daniela Witten, Trevor Hastie , Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer 2017 5. John Chambers , Software for Data Analysis: Programming with R, 2008 6. Joseph Adler , R in a Nutshell, O'Reilly, Sebastopol, 2009
	2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014. 3. S M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Foundation, 2011.	

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

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Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Deepan raj, Visteon, Chennai	1. Dr. Sushama M. Bendre, Professor, Indian Statistical Institute, Applied Statistical Unit, Chennai.	1. Dr. M. Thenmozhi
2. Dr. C.K. Chandrasekhar, Data Science Consultant	2. Dr. R. Srinivasan, Professor, SSN college of Engineering, Kalavakkam	

Course Code	20ITC503J	Course Name	BIG DATA TECHNOLOGY		Course Category	C	Professional Core				L	T	P	C
											3	0	2	4
Pre-requisite Courses	<i>Nil</i>		Co-requisite Courses	<i>Nil</i>		Progressive Courses								
Course Offering Department	<i>Information Technology</i>			Data Book / Codes/Standards	<i>Nil</i>									

Course Learning Rationale (CLR):		<i>The purpose of learning this course is to:</i>			Learning			Program Learning Outcomes (PLO)																	
CLR-1 :	<i>Utilize the Hadoop architecture and its use cases</i>				1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-2 :	<i>Create mapper and reducer functions to build Hadoop applications</i>				Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning			
CLR-3 :	<i>Understand key design considerations for data ingress and egress tools in Hadoop</i>							L	H	-	H	L	-	-	-	L	L	-	H	-	-	-	-	-	-
CLR-4 :	<i>Review about MongoDB Aggregation framework</i>							M	H	M	M	H	-	-	-	M	L	-	H	-	-	-	-	-	-
CLR-5 :	<i>Infer about different kind of ecosystem tools in Hadoop</i>							M	H	M	H	M	-	-	-	M	L	-	H	-	-	-	-	-	-
								H	H	M	H	H	-	-	-	M	L	-	H	-	-	-	-	-	-
Course Learning Outcomes (CLO):		<i>At the end of this course, learners will be able to:</i>																							
CLO-1 :	<i>Understand Hadoop architecture and its Business Implications</i>				1	80	70																		
CLO-2 :	<i>Build reliable, scalable distributed system with Apache Hadoop</i>				1	85	75																		
CLO-3 :	<i>Import and export data into Hadoop Distributed File system</i>				2	75	70																		
CLO-4 :	<i>Interpret MongoDB design goals and setup MongoDB environment</i>				2	85	80																		
CLO-5 :	<i>Develop Big Data Solutions using Hadoop Eco System tools</i>				3	85	75																		

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	<i>Introduction to Big Data and its importance</i>	<i>Hadoop Map Reduce paradigm</i>	<i>APIs used to Write/Read files into/from Hadoop</i>	<i>History of NoSQL Databases</i>	<i>Introduction to Ecosystem tools</i>				
	SLO-2	<i>Basics of Distributed File System</i>	<i>Map and reduce tasks</i>	<i>Need for Flume and Sqoop</i>	<i>Features of NoSQL</i>	<i>Hive Architecture</i>				
S-2	SLO-1	<i>Four Vs, Drivers for Big data</i>	<i>Job Tracker and task tracker</i>	<i>Flume Architecture</i>	<i>NOSQL VS RDBMS</i>	<i>Comparison with Traditional Database</i>				
	SLO-2	<i>Big data applications</i>	<i>Map reduce execution pipeline</i>	<i>The HDFS Sink</i>	<i>Types of NoSQL Databases</i>	<i>HiveQL</i>				
S-3	SLO-1	<i>Structured,unstructured,semistructured and quasi structured data</i>	<i>Key value pair, Shuffle and sort</i>	<i>Partitioning and Interceptors</i>	<i>Key-value stores-Document databases</i>	<i>Querying Data</i>				
	SLO-2	<i>History of Hadoop-Hadoop use cases</i>	<i>Combiner and Partitioner</i>	<i>File Formats</i>	<i>Wide-column stores</i>	<i>Sorting And Aggregating</i>				
	SLO-1				<i>Lab10: HBase-Commands</i>					

S4-5	SLO-2	LAB 1:HDFS Shell Commands – Files and Folders	Lab4: Implementing word count program using map reduce	LAB 7:Write/Read files into/from Hadoop using API		Lab 13:Cluster Management using Zookeeper
	SLO-1	The Design of HDFS	Map reduce example	Fan Out	Graph stores	Map Reduce Scripts
S-6	SLO-2	Blocks and replication management	Understanding input text formats in Hadoop	Data transport using FLUME events	Benefits of NOSQL	Joins & Sub queries
	SLO-1	<u>Rack Awareness</u>	Understanding output formats in Hadoop	Integrating Flume with Applications	Introduction to MongoDB	PIG
S-7	SLO-2	HDFS architecture	Map reduce Algorithms	Introduction to SQOOP	MongoDB document model and basic schema design	Execution Types
	SLO-1	Name node and Data node	Sorting,Searching,Indexing,TF-IDF	SQOOP features	The key MongoDB characteristics	Running Pig Programs
S-8	SLO-2	HDFS Federation	Runtime Coordination and Task Management	Sqoop Architecture	<u>Understanding the MongoDB Ecosystem</u>	Grunt
	SLO-1	LAB 2:HDFS Shell Commands - Management	Lab 5: Finding out Number of Products Sold in Each Country using map reduce with sample dataset	LAB 8: Installing Ecosystem tools	Lab 11: Hive Create, Alter and Drop tables	Lab 14: Execute pig Latin commands-To query dataset stored in HDFS
S-9-10	SLO-2					
	SLO-1	Name node High availability	Hadoop 2.0 features	Sqoop Import All Tables	Diving into create operations	Pig Latin Editors
S-11	SLO-2	Basic Hadoop Shell commands	YARN Architecture	Sqoop Export All Tables	Read operations	Generating Examples
	SLO-1	Anatomy of File Write	MRV1 Vs MRV2	Sqoop Connectors	Update operations	HBase Architecture
S-12	SLO-2	Anatomy of File read	Introduction to Schedulers	A Sample Import	Delete operations	Components, and Use Cases
	SLO-1	Data serialization	YARN scheduler policies	Sqoop Import from MySQL to HDFS	Understanding the Basics and CRUD operations	Comparison of HBase with RDBMS
S-13	SLO-2	Serialization in JAVA and Hadoop	FIFO, Fair And Capacity scheduler	Sqoop vs flume	Update and delete operation	HBase Create Table with Example
	SLO-1	Lab 3: Steps to run map reduce program	Lab 6: Find matrix multiplication using map reduce	LAB 9: Scoop – Move Data into Hadoop	Lab 12:Pig Latin Scripts in three modes	Lab 15:Twitter Data Analytics for understanding big data technologies.
S-14-15	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Tom White, —HADOOP: The definitive Guide , O Reilly 2012. 2. Chris Eaton, Dirk deroos et al. , —Understanding Big data McGraw Hill, 2012. 3. Vignesh Prajapati, —Big Data Analytics with R and Hadoop Packet Publishing 2013. 4. http://www.bigdatauniversity.com/ 	
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)				Final Examination (40% weightage)		
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. SivaKumar, Sr. Consultant, rsivakoumar@gmail.com A2O Integrated services Pvt., Ltd., Chennai	1. Dr. S Muthurajkumar, Asst. Professor, Department of Computer Technology, muthuraj@annauniv.edu, MIT Campus, Anna University, Chromepet, Chennai-600044.	1. Ms. S. Sindhu
		2. Dr. G. Maragatham

Course Code	20ITC504J	Course Name	MACHINE LEARNING FOR DATA ANALYTICS	Course Category	C	Professional Core			
						L	T	P	C
						3	0	2	4
Pre-requisite Courses	Nil		Co-requisite Courses	Nil		Progressive Courses			
Course Offering Department	Information Technology			Data Book / Codes/Standards	Nil				

Course Learning Rationale (CLR):		Learning			Program Learning Outcomes (PLO)														
CLR-1 :		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
The purpose of learning this course is to:																			
To introduce the Concept of data , characteristics of data and Preprocessing Techniques																			
To introduce Classification Techniques Basic methods – Supervised Machine learning																			
To introduce Classification Techniques Advanced methods – Supervised Machine learning																			
To introduce Clustering Techniques – Un Supervised Machine learning																			
To introduce Reinforcement Learning Techniques																			
Course Learning Outcomes (CLO):		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
At the end of this course, learners will be able to:																			
CLO-1 : Understanding the Pre-processing concepts in Machine Learning		1	80	70	H	H	H	H	H	-	H	-	H	-	-	-	-	-	M
CLO-2 : Understanding the Basic level Supervised learning Techniques with working knowledge		1	85	75	H	H	H	H	H	-	H	-	H	-	-	-	-	-	L
CLO-3 : Understanding the Advanced Supervised learning Techniques with working knowledge		2	75	70	H	H	H	H	H	-	H	-	H	-	-	-	-	-	L
CLO-4 : Understanding the Un Supervised learning Techniques with working knowledge		2	85	80	H	H	H	H	H	-	H	-	H	-	-	-	-	-	L
CLO-5 : Understanding the concept of Reinforcement learning and its applications		3	85	75	H	H	H	H	H	-	H	-	H	-	-	-	-	-	L
		3	80	70	H	H	H	H	H	-	H	-	H	-	-	-	-	-	M

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Basics - Data Objects and Attribute types	Classification : Basics	Classification- Advanced Methods	Cluster Analysis : Basic concepts and Methods	Reinforcement learning : Basics
	SLO-2	Types : Nominal, Binary, Ordinal, Numeric, Discrete Vs Continuous Attributes	Introduction to Classification , General Approach to Classification	Concepts and Mechanisms	Introduction to Cluster Analysis	Introduction : Definition and purpose
S-2	SLO-1	Basic Statistical Descriptions of Data	Decision Tree Induction	Bayesian Belief Networks	Cluster Analysis	Reinforcement learning: Basics

	SLO-2	Measuring the Central Tendency, Measuring the Dispersion of Data.	Basics of Decision Tree Induction, Attribute Selection Measures	Training Bayesian Belief Networks	Requirements for Cluster Analysis, Overview of Basic Clustering Methods	Important terms : Agent , Environment, Reward, state, Policy, value etc.,
S-3	SLO-1	Data Pre processing	Decision Tree Induction	Classification by Back Propagation	Partitioning Methods	Reinforcement learning : Basics
	SLO-2	Data Quality	Tree Pruning, Scalability & Decision Tree Induction	A Multilayer Feed-Forward Neural Networks	K-Means : A Centroid Based Technique	How Reinforcement Works ?
S-4-5	SLO-1	Lab 1: Data Pre processing Techniques using Python	Lab4 :Decision Tree Implementation using Python	Lab 7 : BPN Implementation - python	Lab10: K – Means Implementation - python	Lab 13: Study exercise – Reinforcement learning
	SLO-2	Data Pre processing	Bayes' Classification Methods	Classification by Back Propagation	Partitioning Methods	Reinforcement Learning Algorithms–
S-6	SLO-1	Major Tasks in Data Pre processing	Bayes' Theorem , Naïve Bayesian Classification	Defining a Network Topology	K-Medoids : A Representative Object-Based Technique	Value Based , Policy Based
	SLO-2	Data Cleaning	Rule Based Classification	Classification by Back Propagation	Hierarchical Methods	Reinforcement Learning Algorithms–
S-7	SLO-1	Missing Values	Using IF-THEN Rules for Classification, Rule Extraction from Decision Tree, Rule Induction using a sequential Covering Algorithm	Back Propagation	Agglomerative Vs Divisive Hierarchical Clustering	Model Based learning
	SLO-2	Data Cleaning	Model Evaluation and Selection	Classification by Back Propagation	Hierarchical Methods	Reinforcement Learning Characteristics
S-8	SLO-1	Noisy data, Data cleaning as a Process	Metrics for Evaluating Classifier Performance, Holdout Method for Random Subsampling	Inside the Black Box: Back Propagation and Interpretability	Distance measures in Algorithmic Methods	Features of Reinforcement learning
	SLO-2	Lab 2: Lab 1: Data Pre processing Techniques using Python	Lab 5: Bayes Classification with python	Lab 8: SVM Implementation using python	Lab 11: Hierarchical clustering Implementation	Lab 14: Try out exercise with Policy based learning
S-9-10	SLO-1	Data Integration	Model Evaluation and Selection	Support Vector Machines	Hierarchical Methods	Types of Reinforcement Learning
	SLO-2	Entity Identification Problem , Redundancy and Correlation Analysis	Cross validation, Bootstrap, Model selection Using statistical Tests of Significance	The case when the Data are Linearly separable	BIRCH : Multiphase hierarchical Clustering using Clustering feature Trees	Positive, Negative
S-11	SLO-1	Data Reduction	Techniques to Improve Classification Accuracy	Support Vector Machines	Density- Based Methods	Learning Models of Reinforcement
	SLO-2	Overview of Data Reduction Strategies, wavelet Transforms	Ensemble methods, Bagging, Ada Boost	The case when the Data are Linearly Inseparable	DBSCAN	Markov Decision Process, Q-Learning
S-12	SLO-1	Data Reduction	Techniques to Improve Classification Accuracy	Other Classification Methods	Evaluation of Clustering	Applications of Reinforcement learning,
	SLO-2	Principal Components Analysis, Attribute Subset Selection	Random Forests	Genetic Algorithms, Rough set Approach and Fuzzy set Approaches	Assessing Clustering Tendency, Determining the Number of Clusters, Measuring the Clustering Quality	Challenges of Reinforcement learnin

S 14- 15	SLO-1	Lab 3: Lab 1: Data Pre-processing Techniques using Python	Lab 6: Model selection - python	Lab9: Comparison of Models using statistical measures	Lab 12: Cluster Evaluation - python	Lab 15 :Understanding Q-learning - python
	SLO-2					

Learning Resources	1. <i>Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition</i> , by Aurélien Géron, ISBN-13: 978-1492032649 .,ISBN-10: 1492032646	3. <i>Hands-on Scikit-Learn for Machine Learning Applications: Data Science Fundamentals with Python</i> David Paper Logan, UT, USA ISBN-13 (pbk): 978-1-4842-5372-4 ISBN-13 (electronic): 978-1-4842-5373-1
	2. <i>Data Mining Concepts and Techniques</i> ,Jiawei Han , Micheline Kamber, Jian Pei, 3 rd edition, Elsevier, ISBN : 978-0-12-381479-1	4. <i>Reinforcement Learning with Open AI, Tensor flow and keros using python.</i> , Abhishek Nandy Manisha Biswas Kolkata, West Bengal, India North 24 Parganas, West Bengal, India ISBN-13 (pbk): 978-1-4842-3284-2 ISBN-13 (electronic): 978-1-4842-3285-9

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)	Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Venkatesan Ganesan, Sr. Consultant ,TCS, Australia	1. Dr. Godfrey winster, Professor, Dept of Computer Science and Engineering, SaveethaEngg. College, Chennai – 602 105	Dr. G.Maragatham, SRMIST, KTR
		Dr.G.Vadivu, SRMIST, KTR

Course Code	20ITE505J	Course Name	CLOUD COMPUTING FOR DATA ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards			Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 : Understand the basics of Cloud environment		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
CLR-2 : Understand the Virtualization environment in cloud					H	H	H	M	H	M	M	M	M	M	L	M	M	M	M
CLR-3 : Utilize network to create cloud platform					H	H	H	H	H	M	M	H	M	H	M	H	M	M	H
CLR-4 : Utilize the storage devices and protocols in cloud					H	H	H	H	H	M	M	H	M	H	M	H	M	M	H
CLR-5 : Understand the security concerns in Cloud environment					H	H	H	H	H	M	M	H	M	H	M	H	M	M	H
CLR-6 : Understand the basics of Cloud environment					H	H	H	H	H	M	M	M	H	H	M	H	H	H	M
CLO-1 : Understand the Cloud service and deployment models	At the end of this course, learners will be able to:	4	70	60															
CLO-2 : Create virtualization techniques in cloud environment		5	75	60															
CLO-3 : Construct network virtualization environment		5	75	60															
CLO-4 : Create storage handling in cloud environment		5	75	60															
CLO-5 : Develop a security mechanisms in cloud environment		5	75	60															
CLO-6 : Understand the Cloud service and deployment models		6	85	80															

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction to Cloud	Introduction Virtualization	Overview of network virtualization	Introduction of storage cloud		Security for Virtualization Platform			
	SLO-2	Components of Cloud Computing			Storage Evolution					
S-2	SLO-1	Comparing Cloud Computing with Virtualization	Implementation models of Virtualization	Virtualization tools that enable network virtualization	Data Center infrastructure				Host security for SaaS, PaaS and IaaS	
	SLO-2	Grids, Utility Computing								
S-3	SLO-1	client server model	VMM- Deisgn Requirements and Providers	Benefits of network virtualization	Host components,				Data Security	

Duration (hour)		15	15	15	15	15
	SLO-2	<i>P-to-P Computing</i>	<i>Virtualization at OS level</i>		<i>Connectivity, Storage</i>	
S4-5	SLO-1	<i>Lab 1: Install Virtualbox/VMware Workstation with different flavours of linux</i>	<i>Lab4 :Create a virtual Machine and deploy a simple instance</i>	<i>Lab 7 : Transfer the files from one virtual machine to another virtual machine.</i>	<i>Lab 10: Procedure to launch virtual machine using trystack</i>	<i>Lab 13: Generate a private key, Access using SSH client</i>
	SLO-2					
S-6	SLO-1	<i>Impact of Cloud Computing on Business</i>	<i>Middle-ware support for Virtualization</i>	<i>Block-level virtualization</i>	<i>Storage Protocols Cloud Storage Architecture</i>	<i>Data Security Concerns</i>
	SLO-2					
S-7	SLO-1	<i>Key Drivers for Cloud Computing</i>	<i>Virtualization structure/tools and mechanisms</i>	<i>File-level virtualization</i>	<i>Storage -as-a-Service</i>	<i>Data Confidentiality and Encryption</i>
	SLO-2	<i>Cloud computing Service delivery model</i>	<i>Hypervisor and Xen Architecture</i>			
S-8	SLO-1	<i>Service Models: Software as a Service, Platform as a Service</i>	<i>Virtualization of CPU</i>	<i>IP Storage Area Network (IP SAN) iSCSI</i>	<i>Advantages of Cloud Storage</i>	<i>Data Availability</i>
	SLO-2	<i>Infrastructure as a Service</i>				
S9-10	SLO-1	<i>Lab 2: Install Virtualbox/VMware Workstation with different flavours of linux</i>	<i>Lab 5: Service Deployment & usage over cloud</i>	<i>Lab 8: Performance evaluation of services over cloud</i>	<i>Lab 11:Online Opens tack Demo Version</i>	<i>Lab 14: Deploy a simple web application</i>
	SLO-2					
S-11	SLO-1	<i>Cloud Types – Private, Public and Hybrid</i>	<i>Memory and I/O Devices</i>	<i>FCIP with architecture</i>	<i>Amazon S3</i>	<i>Data Integrity</i>
	SLO-2					
S-12	SLO-1	<i>Advantages and Disadvantages of public, Private cloud models</i>	<i>Memory Virtualization</i>	<i>FCoE architecture</i>	<i>Amazon Glacier</i>	<i>Cloud Storage Gateways</i>
	SLO-2					
S-13	SLO-1	<i>Cloud API – Design Requiremnts</i>	<i>I/O Virtualization</i>	<i>Comparison of FCIP and FCoE architectures</i>	<i>AWS Glue</i>	<i>Cloud Firewall</i>
	SLO-2					
S14-15	SLO-1	<i>Lab 3: Install Virtualbox/VMware Workstation with windows OS on top of windows7 or 8.</i>	<i>Lab 6: Manage Cloud Computing Resources</i>	<i>Lab9: Case Study: Google App Engine</i>	<i>Lab 12:Case Study: Microsoft Azure</i>	<i>Lab 15 :Case Study: Amazon, Hadoop and Aneka</i>

Learning Resources	1. <i>Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing</i> , Tata Mcgraw Hill, 2013.	7. <i>Ronald L.Krutz, Russell vines, “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”</i> , Wiley Publishing Inc., 2010.
	2. <i>Anthony T .Velte, Toby J.Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”</i> , Tata McGraw Hill Edition, Fourth Reprint, 2010.	8. <i>Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things"</i> , Morgan Kaufmann Publishers, 2012.
	3. <i>Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more”</i> , Jones & Bartlett Learning Company LLC, 013.	

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember	20%	20%	15%	15%	20%	15%	10%
	Understand							
Level 2	Apply	20%	20%	15%	15%	40%	20%	20%
	Analyze							
Level 3	Evaluate	10%	10%	20%	20%	40%	15%	20%
	Create							
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
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Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.Anandha Raman T, Senior Consultant ,TCS,Chennai	1. Dr.Muthuram Assistant Professor ,Government College of Technology,Coimbatore	1. Dr.K.Venkatesh, SRMIST
	2. Dr.S.Sudarapandiyan CRIST ,Bangaluru	2. Dr.M.Saravanan SRMIST

Course Code	20ITE506J	Course Name	ADVANCED ALGORITHMS ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:					Learning			Program Learning Outcomes (PLO)															
CLR-1 :	To understand the design, analysis, implementation, and scientific evaluation of algorithms to solve critical problems					1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Comprehensive analysis on the application and analysis of algorithmic paradigms to both the (traditional) sequential model of computing and to a variety of parallel models.					Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning	
CLR-3 :	In depth study over the search algorithms and an descriptive analysis on the same																							
CLR-4 :	Exploration of parallel and distributed algorithms																							
CLR-5 :	Analyze and understand search algorithms used in analytics																							
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																							
CLO-1 :	Learns the detailed introduction on algorithms and their types					1	85	75	L	H	H	H	M	-	-	M	-	-	-	-	-	-	H	
CLO-2 :	Knows the design strategies of writing algorithms					2	80	70	L	M	H	H	M	-	-	M	-	-	-	-	-	-	-	H
CLO-3 :	Gain an understanding of graph and network based algorithms					2	75	70	L	H	H	M	M	-	-	L	-	-	-	-	-	-	M	
CLO-4 :	Comprehensive study over parallel and distributed algorithms					3	80	70	L	H	H	H	M	-	-	M	-	-	-	-	-	-	-	H
CLO-5 :	Know how the search algorithms are used in analytics					3	85	75	L	M	H	H	M	-	-	M	-	-	-	-	-	-	-	H

Duration (hour)	15		15		15		15		15	
S-1	SLO-1 SLO-2	Introduction to concepts in design of algorithms	Major Design Strategies	Graph algorithms	Parallel Algorithms	String Matching				
S-2	SLO-1 SLO-2	Design and Analysis Fundamentals	Major Design Strategies – Examples and case studies	Network Algorithms	Distributed Algorithms	Document Processing				
S-3	SLO-1 SLO-2	Design and Analysis Fundamentals – Demo and Examples	The Greedy Method	Graph and Network Algorithms – Demo and examples	Parallel and Distributed Algorithms – Demo and Examples	Balanced Search Trees				
S4-5	SLO-1 SLO-2	Lab 1: Implementation of algorithms along with datasets	Lab4 :Implementation of greedy method	Lab 7 :Applying graph and network algorithms	Lab10: Implementation of parallel and distributed algorithms	Lab 13: Implementation of balanced search trees				
S-6	SLO-1 SLO-2	Mathematical Tools for Algorithm Analysis	Divide and Conquer	Graphs and Digraphs	Introduction to Parallel Algorithms	The Fast Fourier Transform Heuristic Search Strategies				

Duration (hour)		15	15	15	15	15
S-7	SLO-1	Trees and Applications to Algorithms	Dynamic Programming	Minimum Spanning Tree	Introduction to Parallel Architectures	A* - Search
	SLO-2					
S-8	SLO-1	Trees and Applications to Algorithms – Demo and examples	Divide and Conquer & Dynamic Programming –Demo and Examples	Shortest- Path Algorithms	Parallel Design Strategies	Game Trees 24
	SLO-2					
S9-10	SLO-1	Lab 2: Implementation of trees	Lab 5: Implementation of divide and conquer and dynamic programming algorithms	Lab 8: Implementation of MST and shortest path algorithms	Lab 11:Implementation of parallel and distributed algorithms	Lab 14:Implementation of heuristic search strategies
	SLO-2					
S-11	SLO-1	More on Sorting Algorithms	Backtracking	Graph Connectivity	Internet Algorithms	Probabilistic and Randomized Algorithms
	SLO-2					
S-12	SLO-1	Probability of algorithms	Branch and Bound	Fault-Tolerance of Networks	Distributed Computation Algorithms	Lower-Bound Theory NP-Complete Problems
	SLO-2					
S-13	SLO-1	Average Complexity of Algorithms	Backtracking ,Branch and Bound – Demo and Examples	Matching and Network Flow Algorithms	Distributed Network Algorithms	Approximation Algorithms
	SLO-2					
S14-15	SLO-1	Lab 3: Implement measurement of complexity	Lab 6: Implementation of backtracking, branch and bound algorithms	Lab9: Implementation of matching and network flow algorithms	Lab 12:Implementation of network flow algorithms	Lab 15 :Implementation of Probabilistic and Randomized Algorithms
	SLO-2					

Learning Resources	1. Kenneth A. Berman, Jerome L. Paul , “Algorithms: Sequential, Parallel, and Distributed”, Amazon Bestsellers, 2004.	3. Dimitri P. Bertsekas and John N. Tsitsiklis, “Parallel and Distributed Computation: Numerical Methods”, Prentice Hall, 1989.
	2. Russ Miller, Laurence Boxer, “Algorithms Sequential and Parallel: A Unified Approach”, Prentice Hall, 1 edition, 1999.	

	Bloom’s Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)				#CLA-3 (15%)	Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)			Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Deepan raj, Visteon, Chennai	1. Dr. Sushama M. Bendre, Professor, Indian Statistical Institute, Applied Statistical Unit, Chennai.	1. Dr. Thenmozhi
2. Dr. C.K. Chandrasekhar, Data Science Consultant	2. Dr. R. Srinivasan, Professor, SSN college of Engineering, Kalavakkam	2. G. Sujatha

Course Code	20ITE507J	Course Name	PYTHON PROGRAMMING FOR DATA ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards			Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Utilize the different packages in Python for array processing
CLR-2 :	Utilize the different advanced data structures for data processing
CLR-3 :	Working with various data formats
CLR-4 :	Utilize appealing visualization options for exploratory analysis
CLR-5 :	Utilize data analytics options available in Python for real-time application development

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
1	80	70
1	85	75
2	75	70
2	85	80
3	85	75

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
L	H	M	H	L	-	-	-	L	L	-	-	-	-	M
H	H	H	M	M	-	-	-	M	L	-	-	-	-	M
M	H	H	H	L	-	-	-	M	L	-	-	-	-	M
M	H	H	H	M	-	-	-	M	L	-	-	-	-	M
H	H	H	H	M	-	-	-	M	L	-	-	-	-	M

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Create different real time applications using the various packages
CLO-2 :	Create and explore different operations on advanced data structures
CLO-3 :	Handle different data formats from different sources of data
CLO-4 :	Create effective visualizations for data representation and analysis
CLO-5 :	Apply the data analytics features in real world problem solving

Duration (hour)	15		15	15	15	15
S-1	SLO-1	Getting started with Python Programming	Dataframes	Reading and writing JSON	Elements of a matplotlib chart	Textual Data Analysis:Regular Expressions
	SLO-2	Python Basics				
S-2	SLO-1	Getting started with Python libraries Library for Data analysis	Querying data	Reading and writing - HDFS	Histogram	NLTK library
	SLO-2	Libraries for Mathematical functionalities and tools (SCIKITLEARN, NUMPY), Numerical Plotting Library (MATPLOTLIB)				
S-3	SLO-1	Creating arrays and scalars	Data aggregation		Line and Bar charts	sentiment analysis

Duration (hour)		15	15	15	15	15
	SLO-2	Operations on arrays		Storing data with PyTables, Parquet data, Pystore		
S4-5	SLO-1	Lab 1: Implementation of scalars and arrays	Lab4 :Implementation of different aggregation operations on pandas data frames	Lab 7 :Reading and writing JSON data in PyTables	Lab10: Implementation of histogram, line and bar charts	Lab 13: Implementation of sentiment analysis on micro messages data set
	SLO-2					
S-6	SLO-1	Stacking arrays	Operations on data frames	Parsing RSS feeds and Parsing web page tables using pandas library	Multiseries and stacked	word clouds
	SLO-2					
S-7	SLO-1	Transposition	Indexing and reindexing	Webscraping technique using python BeautifulSoup Library, Request library, Selenium library and Scrapy	Advanced Charts	frequency of words
	SLO-2	Vectorization				
S-8	SLO-1	Broadcasting	sorting and ranking	Pickling for object serialization	Seaborn	bigrams and collocations
	SLO-2	Random numbers				
S9-10	SLO-1	Lab 2: Implementation of transposition and vectorization on arrays	Lab 5: Indexing, sorting and ranking	Lab 8: Implementation of parsing RSS and HTML, pickling	Lab 11: Implementation of multiseries and stacked	Lab 14:Implementation of word clouds and frequency of words
	SLO-2					
S-11	SLO-1	Descriptive statistics	Hierarchical indexing and levelling	Loading data with SQLite3	Kernel density estimate plots	Imaging Libraries for Python OpenCV
	SLO-2					
S-12	SLO-1	Linear algebra with numpy – Matrix operations and eigen values	Function application	Writing data with SQLite3	Box and violin plots	Operations on images-edge detection-image
	SLO-2		Binning-permutation			
S-13	SLO-1	Linear algebra with numpy – Solving equations	Pivoting	Loading and writing data with PostGRESQL	Heatmaps and clustered matrices	gradient analysis
	SLO-2		Cross tabulation			
S14-15	SLO-1	Lab 3: Implement linear algebra on numpy arrays	Lab 6: Implementation of pivot tables and cross tabulation	Lab9: Writing data into SQLite3 and POSTGRESQL	Lab 12:Implementation of kernel density plots	Lab 15 :Implementation of image classification
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Fabio Nelli, "Python Data Analytics: With Pandas, NumPy, and matplotlib", Apress, 2nd Edition, 2018 2. Ivan Idris, "Python Data Analysis", Packt Publishing, 2nd Edition, 2017 3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 1st Edition, 2016 4. Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010. 5. Mark Lutz, "Learning Python", O'Reilly Media, 5th Edition, 2013. 6. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 1st edition, 2009. 	<ol style="list-style-type: none"> 7. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005. 8. Shai Vaingast, "Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd edition, 2014. 9. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012. 10. Wesley J. Chun, "Core Python Applications Programming, 3rd ed, Pearson, 2016 11. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019. 12. Automate the Boring Stuff with Python by Al Sweigart.
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
Total		100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. A.G.Rangaraj, Deputy Director (Technical), R&D, RDAF and SRRD Division, National Institute of Wind Energy (NIWE)	1. Dr. I. Joe Louis Paul, Associate Professor, SSN College of Engineering	1. Ms. K. Sornalakshmi, SRMIST
		2. Dr. G. Vadivu, SRMIST

Course Code	20ITE508J	Course Name	FUNCTIONAL PROGRAMMING FOR DATA ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards			Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:			Learning			Program Learning Outcomes (PLO)														
CLR-1 :	Understands to basic functional types			1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	Utilize the Higher order functions and data sharing			Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
CLR-3 :	Utilize the parallelism in Application Interfaces																				
CLR-4 :	Utilize the Functional Design Patterns in various application																				
CLR-5 :	At the end of this course, learners will be able to:																				
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																				
CLO-1 :	Understands to basic functional types			1	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	understands the functional data structures & exception handling			1	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Utilize the Functional State And Parallelism			2	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Apply the Functional Design & Functional Design Patterns			2	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Design Applicative Traversable Functors & Io			3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-

Duration (hour)	15	15	15	15	15
S-1	SLO-1 Non- Functional programming	Defining functional data structures	Strict and non-strict functions	Parser Combinators Introduction	Generalizing monads
	SLO-2 Functional programming				
S-2	SLO-1 Benefits of Functional Programming in Scala	Pattern Matching	Lazy Lists Example	Design Algebra	Applicative trait
	SLO-2 Functional Programming Examples				

Duration (hour)		15	15	15	15	15
S-3	SLO-1	Referential Transparency	Variadic functions in Scala	infinite Steams and co recursion	Handle context sensitivity	Monads vs Applicative functors
	SLO-2	RT Example			Error Reporting	
S4-5	SLO-1	Lab 1: Functional Programming basic in Scala	Lab4 : Implement pattern matching	Lab 7 : Implement lazy lists	Lab 10: Implement Parser Combinators	Lab 13: Implement applicative functors
	SLO-2					
S-6	SLO-1	Purity and Substitution	Data sharing in functional data structures	Making stateful APIS	Implementing algebra	Traversable functors
	SLO-2	Model			Folding Lists with monoids	
S-7	SLO-1	Modules, Objects	Recursion over lists	pure data types for parallel computations	Associativity and Parallelism	Uses of Traverse
	SLO-2	Namespaces			Foldable data structures	
S-8	SLO-1	Basic Functions	Generalizing to higher order functions	Combining parallel computations	Composing monoids	Factoring Effects
	SLO-2	Higher order functions				
S9-10	SLO-1	Lab 2: Implementation of higher order functions	Lab 5: Implement generalizing to higher order functions	Lab 8: Implement pure data types	Lab 11: Implement monoids	Lab 14: Implement traversable functors
	SLO-2					
S-11	SLO-1	Polymorphic functions	Trees	Explicit forking	Monads: Functors – Monads,	Simple IO type
	SLO-2					
S-12	SLO-1	Tail calls	Alternative to exceptions	Refining API, Algebra of API	Monadic Combinators	Avoiding Stack Overflow
	SLO-2					
S-13	SLO-1	Following types to implementations.	Option and Either data types	Refining combinators	Monad Laws	Non blocking and asynchronous
	SLO-2					
S14-15	SLO-1	Lab 3: Implementation of tail calls and polymorphic functions	Lab 6: Implement trees, option and either data types	Lab9: Implement combinators	Lab 12: Implement Monads	Lab 15 : Implement Simple IO

Learning Resources	<ol style="list-style-type: none"> 1. Paul Chiusano and Rúnar Bjarnason, "Functional Programming in Scala", Manning Publishers, 2014. 2. Dean Wampler, Alex Payne, "Programming Scala", O'Reilly Media, 2009. 3. Scala by Example www.scala-lang.org/docu/files/ScalaByExample.pdf 4. Martin Odersky, "Scala Language Specification", 2008, http://www.scala-lang.org/docu/files/ScalaReference.pdf 5. Scala Library Documentation : http://www.scala-lang.org/docu/files/api/index.html
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)	Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember	20%	20%	15%	15%	20%	15%	10%
	Understand							
Level 2	Apply	20%	20%	15%	15%	40%	20%	20%
	Analyze							
Level 3	Evaluate	10%	10%	20%	20%	40%	15%	20%
	Create							
Total		100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. <i>Mr.Anandha Raman T, Senior Consultant ,TCS,Chennai</i>	1. <i>Dr.Muthuram Assistant Professor ,Government College of Technology,Coimbatore</i>	1. <i>K.Sornalakshmi</i>

Course Code	20ITE509J	Course Name	MARKETING ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)																																
CLR-1 : solve specific business problems using powerful analytic techniques		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
CLR-2 : forecast sales and improve response rates for marketing campaigns		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning																		
CLR-3 : Explores how to optimize price points for products and services																																					
CLR-4 : optimize store layouts																																					
CLR-5 : improve online advertising																																					
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																																				
CLO-1 : effectively provide solutions to business problems		1	80	70	H	H	H	H	M	H	-	M	-	H	M	M	-	M	M																		
CLO-2 : predict sale trends and design marketing campaigns		2	75	70	H	M	H	H	M	H	-	M	-	H	M	M	-	M	M																		
CLO-3 : build effective price points for products and services		2	85	75	H	H	H	H	L	H	-	M	-	H	M	M	-	M	M																		
CLO-4 : design store layouts for optimal marketing		3	75	70	H	M	H	H	M	H	-	M	-	H	M	M	-	M	M																		
CLO-5 : provide efficient online advertising strategies		3	80	70	H	H	H	H	L	H	-	M	-	H	M	M	-	M	M																		

Duration (hour)	15	15	15	15	15	
S-1	SLO-1 SLO-2	Intro to market and digital market	Regression Introduction	Clustering	Conjoint analysis	Social media channels and their utility,
S-2	SLO-1 SLO-2	Summarisation of data	linear regression	Clustering – demo and examples	Discrete Choice analysis	Facebook marketing
S-3	SLO-1 SLO-2	Central tendency methods	logistic and multiple regression		Conjoint and discrete choice – demo and examples	YouTube marketing
S4-5	SLO-1 SLO-2	Lab 1: 1.Summarization of data using excel	Lab4 :Implementation of Linear,logistic and Multiple regression	Lab 7 :Clustering case studies and examples	Lab10: Implementation of Conjoint analysis, Discrete choice analysis	Lab 13: Implementation of theme and variation

Duration (hour)		15	15	15	15	15
S-6	SLO-1	distribution methods	modelling events	User based collaborative filtering	Customer value	twitter marketing,
	SLO-2	relation between variables	Modelling trend and seasonality			
S-7	SLO-1	correlation, covariance and collinearity;	Ratio to moving average forecasting method	Collaborative filtering	Customer value benefits	Online Reputation management
	SLO-2					
S-8	SLO-1	ANOVA; Visualisation tools	Ratio to moving average forecasting method Demo and Examples	Retailing introduction	Customer value case studies	Influencer marketing.
	SLO-2	histogram, lift charts, confusion matrix,				
S9-10	SLO-1	Lab 2: Implementation of Graph and Histogram	Lab 5: Time series analysis for forecasting, Classification and segmentation using R	Lab 8: Collaborative filtering	Lab 11: Implementation of customer value analysis using data analysis	Lab 14: Implementation of Introspective feedback
	SLO-2					
S-11	SLO-1	boxplot	Winter's method;	market basket analysis	Customer behaviour and marketing strategy	Other Social Media Marketing channels
	SLO-2	Statistical testing				
S-12	SLO-1	A/B testing	Using neural networks	Marketing analytics tool	Survival analysis	Social Media Marketing strategy
	SLO-2					
S-13	SLO-1	t-test and f-test	Using neural networks – Demo and examples	Principal Component Analysis	Marketing strategy and survival analysis – Demo and examples	Automation
	SLO-2					
S14-15	SLO-1	Lab 3: Implement box plots and testing	Lab 6: Implementation of Winters method and moving average method, Neural networks	Lab9: Implementation of Market basket analysis	Lab 12: Analysis of marketing strategy	Lab 15 :Implementation of mock disaster, crowdsource posting
	SLO-2					

Learning Resources	1.	Wayne.L. Winston, "Marketing Analytics: Data driven techniques with MS-Excel", Wiley, 2 nd edition, 2016.	1. "Marketing Analytics a practical guide to real marketing science "by Mark Grigsby, Kogan, 1 st edition, 2015. 2. "Social Media Marketing :A Strategic Approach Paperback" Melissa S. Barker , Donald .Barker , Nicholas F. Bormann , Krista E. Neher, 1 st edition
	2.	"R for marketing research and analysis" by Chris Chapman and Elea Mc Donnell Feit , springer, 2015	

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)	Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember	20%	20%	15%	15%	20%	15%	10%
	Understand							
Level 2	Apply	20%	20%	15%	15%	40%	20%	20%
	Analyze							
Level 3	Evaluate	10%	10%	20%	20%	40%	15%	20%
	Create							
Total		100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.Selvakumar,Hexaware system,Siruseri	1. Dr.Prakash,Associate professor, Dept of Information technology,B.S.Abdul Rehman University,Vandalur	1. Mr. N. Arivazhagan, SRMIST

Course Code	20ITE514T	Course Name	RISK ANALYTICS	Course Category	E	Professional Elective	L 3	T 1	P 0	C 4
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Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses						
Course Offering Department	Information Technology	Data Book / Codes/Standards	Nil							

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Comprehend the functioning of Banking and apply analytic techniques to mitigate risks
CLR-2 :	Explore the operations of Insurance sector
CLR-3 :	Apply analytic techniques to mitigate risks and improve profitability
CLR-4 :	Analyze the processes involved in Healthcare industry and use data analysis to improve patient care and optimize cost
CLR-5 :	Utilize human relationship management techniques for effective management of people

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
1	80	75
1	85	75
2	75	70
3	85	70
3	85	70

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
H	M	M	M	-	L	L	M	-	-	M	-	-	-	-
H	M	M	M	L	M	L	L	-	-	H	L	-	L	L
H	L	M	L	L	L	L	M	-	-	M	-	-	L	L
H	M	M	M	L	M	L	M	-	-	H	L	-	M	M
H	M	M	M	L	M	L	M	-	-	M	L	-	-	L

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Understand the functioning of banking sector for risk mitigation
CLO-2 :	Identify the operations of insurance sector and the associated risks
CLO-3 :	Apply the different analytical techniques
CLO-4 :	Appreciate the processes used in healthcare for optimal services
CLO-5 :	Effectively manage people using relationship management techniques

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Risk Introduction and Impacts with case study examples	Introduction to Banking Sector	Introduction to Insurance Sector	Introduction to Healthcare Sector	Workforce Environment and Psychology
	SLO-2					
S-2	SLO-1	Risk Definition and Examples	National and International laws	Property & Causality Insurance Companies	HIPAA	HR Analytics
	SLO-2					
S-3	SLO-1	Components and Factors	Credit Risk Analytics	Life Insurance Companies	Four Enterprise Disciplines of Health Analytics	Talent Management
	SLO-2					
S-4	SLO-1	Tutorial 1: Discussion with case studies on impacts with risks	Tutorial4 :Compare national and international banking laws with case studies and papers	Tutorial 7 :A comprehensive study on Insurance sector	Tutorial10: A survey on healthcare standards – national and international	Tutorial 13: Analyze workforce Psychology and Talent Management
	SLO-2					
S-5	SLO-1				Health Outcome Analysis	Understanding retention

Duration (hour)		15	15	15	15	15
	SLO-2	Understanding Risk Assessment	Internal capital Adequacy Assessment Process	Using Analytics for Customer Acquisition and Retention		
S-6	SLO-1	Risk Mitigation	Internal capital Adequacy Assessment Process related Risk Analytics	Detecting Fraud	Customer Insights	Predicting Retention
	SLO-2					
S-7	SLO-1	Risk Management	Limit Management	Preventing Fraud	Health Value and Cost	Boosting Employee Engagement
	SLO-2					
S-8	SLO-1	Tutorial 2: Risk mitigation and management plan document	Tutorial 5: Internal capital Adequacy Assessment Process related Risk Analytics	Tutorial 8: Implementation of parsing RSS and HTML, pickling	Tutorial 11:Health Value, Cost and Outcome analysis	Tutorial 14:Retention and employee engagement analytics
	SLO-2					
S-9	SLO-1	Risk Analytics Introduction	Risk-Adjusted Performance Management	Managing Fraud	Actuary Services	Sources of Hire
	SLO-2					
S-10	SLO-1	Risk Analytics Definition and Objectives	Fraud Risk	Detecting, Preventing and Managing Fraud using Analytics	Framework for Customer Analytics	Quality of Hire
	SLO-2					
S-11	SLO-1	Risk Analytics Use cases	Case Studies	Case Studies	Case Studies	Profiling High Performers
	SLO-2					
S-12	SLO-1	Tutorial 3: Explore Risk Analytics	Tutorial 6: Risk-Adjusted Performance Management	Tutorial9: Fraud Handling using analytics	Tutorial 12:Explore available frameworks for customer analytics	Tutorial 15 :Analyze hiring processes and profiling performers
	SLO-2					

Learning Resources	1. Naeem Siddiqi, "Credit Risk Scorecards: Developing and Implementing Intelligent Credit Scoring", ISBN 978-0-471-75451-0	4. Jason Burke, "Health Analytics: Gaining the Insights to Transform Health Care", John Wiley Sons Inc., 2013, ISBN: 978-1-118-38304-9
	2. Clark Abrahams and Mingyuan Zhang, "Credit Risk Assessment: The New Lending System for Borrowers, Lenders, and Investors", ISBN 978-0-470-46168-6	5. Jac Fitz-Enz , John R. Mattox II, "Predictive Analytics for Human Resources", ISBN-13: 978-8126552153.
	3. Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", M.S.ISBN 978-1-118-77221-8	6. James C. Sesil, "Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing Incentives, and Improving Collaboration", ISBN-13: 978-0133064605

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)			Final Examination (40% weightage)
		CLA-1 (20%)	CLA-2 (25%)	#CLA-3 (15%)	
		Theory	Theory		Theory
Level 1	Remember Understand	40%	30%	20%	25%
Level 2	Apply Analyze	40%	30%	40%	40%
Level 3	Evaluate Create	20%	40%	40%	35%
	Total	100 %	100 %	100 %	100 %

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. <i>Mr. Diwaagar Radhakrishnan Sitaraman Esq. Advocate, Vivrti Law</i>		1. <i>Ms. K. Sornalakshmi, SRMIST</i>
		2. <i>Dr.G.Vadivu, SRMIST</i>

Course Code	20ITE510J	Course Name	APPLIED SOCIAL NETWORK ANALYSIS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	20ITE507J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Information Technology	Data Book / Codes/Standards			Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand mathematical concepts of a network and centrality
CLR-2 :	Find the importance of social influence
CLR-3 :	Know about balance networks
CLR-4 :	Learn the concepts and methods of social networks
CLR-5 :	Understand about the algorithms related to web graph searching

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Identify linear and non-linear data structures. Create algorithms for searching and sorting
CLO-2 :	Find the important node in a given graph network
CLO-3 :	Implement to find communities in the graph network
CLO-4 :	Convert unstable to stable network
CLO-5 :	Find the homophily
CLO-6 :	Code page ranking algorithms for web graph

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
3	80	70
3	85	75
3	75	70
3	85	80
3	85	75
3	80	70

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
H	L	H	M	L	-	-	-	L	L	L	-	H	-	M
H	L	M	M	L	-	-	-	M	L	L	-	H	-	M
H	L	M	M	L	-	-	-	M	L	L	-	H	-	M
H	L	L	M	L	-	-	-	M	L	L	-	H	-	M
H	H	M	H	M	-	M	M	H	M	-	-	H	-	H
H	L	H	M	L	-	-	-	L	L	L	-	H	-	M

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction, What is a Network?	Social Networks Structure	Signed Networks	The Prevalence of Social Networks	Web graph				
	SLO-2	Social Networks, Basic Network Concepts	Triads, clustering coefficient neighborhood overlap	Positive and negative edges	Diameter and Small Worlds	Web graph				
S-2	SLO-1	Nodes and Links Adjacency Matrices,	Bridges	Theory of Structural Balance	Clustering, Degree Distributions	Google page ranking using web graph				
	SLO-2	Graphs, and Notation	local bridges	Theory of Status	Correlations and Assortativity	Google page ranking using web graph				
S-3	SLO-1	Types of networks-directed, undirected	Structural holes	Conflict Between the Theory of Balance and Status	Patterns of Clustering	Points distribution method				

Duration (hour)		15	15	15	15	15
	SLO-2	Types of networks- weighed, multigraph, signed	Communities in a graph	Trust in a Network	spatial segregation	Points distribution method
S4-5	SLO-1	Lab1:Introduction to Networkx	Lab 4: Community detection in a graph	Lab 7: Code to find unstable network	Lab 10: Basic model of spatial segregation	Lab 13: Implement Points distribution method
	SLO-2					
S-6	SLO-1	Node attributes, edge attributes	Homophily	Atomic Propagations	Homophily in Spatial Segregation	Random walk method Degree Rank
	SLO-2	Bipartite graphs	Social influence	Propagation of Distrust	The Strength of Weak Ties revisit	Random walk method Degree Rank
S-7	SLO-1	Bipartite graphs	Foci closure	Rounding	Structural Holes, Social Capital	Page rank Hubs
	SLO-2	Datasets-different formats	Foci closure	Perception of User Evaluation	Diffusion	Page rank Hubs
S-8	SLO-1	Connectedness of a graph	membership closure	Effect of Status and Similarity on User Evaluation	Spatial boundary and internal nodes	Page rank Hubs, authorities
	SLO-2	Connectedness of a graph	membership closure	Effect of Similarity on Evaluation	Visualization of boundary and internal nodes	Page rank Hubs, authorities
S9-10	SLO-1	Lab 2: Finding connectedness of a graph	Lab 5: Implement Foci closure, membership closure	Lab 8: Code to count unstable triangles	Lab 11: Visualization of boundary and internal nodes	Lab 14:Implement Random walk method
	SLO-2					
S-11	SLO-1	Graph level measures	Strong, weak ties	Effect of Status on Evaluation	Finding the list of unsatisfied nodes based on Spatial segregation	Power law
	SLO-2	Graph level measures – density, diameter, average centralities	Quantifying triadic closure	Effect of Status on Evaluation	Finding the list of unsatisfied nodes based on Spatial segregation	Power law
S-12	SLO-1	Graph level measures – density, diameter, average centralities	Triadic closure pattern analysis	Aggregate User Evaluation	Analyzing the list of unsatisfied nodes based on Spatial segregation	power law emerges in www graphs
	SLO-2	Centrality measures- degree, closeness	Generating new connections	Aggregate User Evaluation	Analyzing the list of unsatisfied nodes based on Spatial segregation	power law emerges in www graphs
S-13	SLO-1	Centrality measures- betweenness	Generating new connections	Predicting Positive and Negative Links	Visualize the spatial segregation shifted nodes	Rich get richer phenomenon
	SLO-2	Centrality measures- Eigen Vector	Effect of Triadic closure	Convert unstable to stable network	Visualize the spatial segregation shifted nodes	How to be viral
S14-15	SLO-1	Lab 3: Implementation of Centrality measures-degree, closeness, betweenness	Lab 6: Implementing Triadic closure	Lab 9: Code to convert unstable to stable network	Lab 12: Visualize the spatial segregation shifted nodes	Lab 15: Coding the importance of core nodes in cascading
	SLO-2					

Learning Resources	1. Ian McCulloh, Helen Armstrong and Anthony Johnson, "Social Network Analysis with Applications", Wiley Publications, 2013.	4. Maksim tsvetovat, Alexander kouznetsov, "social network analysis for startups", o'reilly, 2011
	2. Matthew O. Jackson, "Social and Economic Networks", Princeton University Press, 2008.	5. Borgatti, S. P., Everett, M. G., & Johnson, J. C., "Analyzing social networks", SAGE Publications Ltd; 1 edition, 2013.
	3. Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge University Press, 2010.	6. John Scott, "Social Network Analysis: A Handbook", SAGE Publications Ltd; 2nd edition, 2000.

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)				#CLA-3 (15%)	Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)			Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Harisekharan, CTO,Sri SeshaaTechnologies Pvt. Ltd.	1. Dr.A.Bhuvanewari, Professor, VIT, School of Computer Science and Engineering,Chennai	1. Dr.G.Vadivu, Professor, IT, SRMIST
2. Mr. S. Sudarsun - Chief Scientific Officer, Claritrics Inc.		2. Ms.K.Sornalakshmi, Assistant Professor, , IT, SRMIST

Course Code	20ITE511J	Course Name	NATURAL LANGUAGE PROCESSING TECHNIQUES	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	To familiarize the basic concepts of NLP	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	To inculcate the knowledge of preprocessing techniques of NLP	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
CLR-3 :	To build probabilistic language models																		
CLR-4 :	To Brief about syntax and semantic techniques																		
CLR-5 :	To design the application models of NLP																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Understand Ambiguity of NLP, Challenges and applications of NLP.	1	80	70	H	M	-	M	L	-	L	-	L	-	-	-	-	-	M
CLO-2 :	Illustrate NLP Techniques such as POS, Morphology ,text Preprocessing	2	85	75	H	L	M	M	M	-	-	L	M	-	-	-	-	-	M
CLO-3 :	Develop applications of probabilistic models	2	75	70	H	H	M	H	H	-	-	L	M	-	-	-	-	-	M
CLO-4 :	Analyze the concepts of syntax and semantics in NLP	3	85	80	H	M	M	H	H	-	-	M	M	-	-	-	-	-	M
CLO-5 :	Implement the applications of NLP using Machine Learning and Deep Learning model	3	85	75	H	M	M	H	H	-	M	H	M	-	-	-	-	-	H

Duration (hour)	15	15	15	15	15
S-1	SLO-1 NLP Overview	NLP Technique	Probabilistic Language Model	Syntax	Pragmatic
	SLO-2 History of NLP	Parts of Speech: Tagsets for English(Penn TreeBank POS Tags	Potter Stemmer	Context Free Grammar	WordSense, WorldNet
S-2	SLO-1 Applications of NLP : Information Retrieval ,Information Extraction, Question Answering	Rule Based POS	Detection and correction of Spelling Errors	Parsing Technique: Top-Down Parsing	Computational Discourse

Duration (hour)		15	15	15	15	15
	SLO-2	Sentiment Analysis Optical Character Recognition Summarization Spell and Grammar Checking	HMM POS	Minimum Edit Distance	Bottom up Parsing	Coherence
S-3	SLO-1	Text Categorization Word Prediction Speech Recognition Machine Translation	Formalizing Hidden Markov Model Taggers	Application of Probabilistic of Models: Word Prediction	Comparing Top Down and Bottom up	Discourse Segmentation
	SLO-2	Classification of NLP	Veterbi Algorithm for HMM Tagging	N-Gram	Dynamic Programming Parsing Methods :CKY Parsing	Text Coherence, Reference Resolution
S4-5	SLO-1	Lab 1: Installing NLP	Lab4 :Implementation of POS Tagging	Lab 7 :Spelling Correction	Lab 10: N-Gram Model	Lab 13: N-Gram Model
	SLO-2	Packages				
S-6	SLO-1	Ambiguity	Phonology	Language Model applications	The Early Algorithm	Information Extraction
	SLO-2	Lexical Ambiguity	Phonetics and Phonology, Syllables	Bag-of-words with N-Gram	Feature Structures & Unification	Named Entity Recognition
S-7	SLO-1	Syntactic Ambiguity	Probabilistic Speech Recognition	The Chain Rule	Feature Structure Types	Rule Based Named Entity Recognition
	SLO-2	Semantic Ambiguity	Morphology: Word ,Morphemes ,Methods of Morphology	Language Model With N-Gram: Unigram model, Bigram Model	Unification of Feature Structures	Evaluation of Named Entity Recognition
S-8	SLO-1	Discourse	Inflectional, Derivational, Cliticization, Non- Concatenative Morphology	Maximum likelihood estimation	Feature Structures in the Grammar	Information Retrieval
	SLO-2	Pragmatic Ambiguity	Finite State Morphological Parsing	Unsmoothed N-Grams	The Representation of Meaning	Evaluation of Information Retrieval
S9-10	SLO-1	Lab 2: Preprocessing Of Text	Lab 5: Tools Of Morphology	Lab 8: N-Gram Model	Lab 11: Semantic	Lab 14: ML Language Models
	SLO-2					
S-11	SLO-1	NLP terminology	Text Preprocessing: Tokenization , Stemming ,Lemmatization	Evaluating N-Grams Perplexity	Computational Desiderata for Representation	Factoid Question Answering
	SLO-2	Components of NLP	Text Preprocessing: removal of Stop Words ,Text Normalization	Smoothing: Laplace Smoothing	Computational Semantics	Text Summarization
S-12	SLO-1	Models & Algorithm	Regular Expression: Basic Regular expression patterns	Interpolation, Backoff	Syntax-Driven Semantic Analysis	Single Document Summarization
	SLO-2	Language, Thought and Understanding	Finite state Automata	Markov Chains :HMM	Lexical Semantics	Machine Translation
S-13	SLO-1	The State of the Art	Deterministic Automata	Likelihood computation	Relations among lexemes and their senses	Machine Learning Model For NLP
	SLO-2	Theory of Language	Non-Deterministic Automata	HMM : Decoding	Event Participants	Deep Learning Model in NLP
S14-15	SLO-1	Lab 3: Language Model	Lab 6: Implementation of Regular Expression	Lab9: Probabilistic Language Model	Lab 12: Applying Event Participants	Lab 15 :Deep Learning Language Model
	SLO-2					

Learning Resources	<ol style="list-style-type: none"> 1. Daniel Jurafsky and James H. Martin "Speech and Language Processing", Prentice Hall, 2009. 2. Christopher D. Manning and Hinrich Schutze, "Foundation of Statistical Natural Language Processing", MIT Press, 1999. 3. Ronald Hausser, "Foundations of Computational Linguistics", Springer-Verlag, 1999. 4. James Allen, "Natural Language Understanding", Benjamin/Cummings Publishing Co. 1995. 5. Steve Young and Gerrit Bloothoof, "Corpus – Based Methods in Language and Speech Processing", Kluwer Academic Publishers, 1997.
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Selvakumar Murugan, Research Engineer at Saama	1. Dr.Jeyashree, Rajalakshmi Institute of Technology	1. S.Dhivya.SRMIST

Course Code	20ITE611J	Course Name	STREAMING ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Information Technology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Utilize the different types of data and understanding the architecture of stream processing
CLR-2 :	Utilize the various messaging systems
CLR-3 :	Utilize data ingestion techniques for real-time applications
CLR-4 :	Utilize different types of stream processing techniques
CLR-5 :	Utilize storage methods of stream data
CLR-6 :	Utilize the different types of visualizing tools of stream data

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:
CLO-1 :	Identify difference between stream and batch processing
CLO-2 :	Implement the different types of message ingestion techniques for stream data
CLO-3 :	Differentiate various messaging systems
CLO-4 :	Implement various stream processing techniques
CLO-5 :	Understand the storage platform for stream data
CLO-6 :	Use various visualization tools for stream data

Learning		
1	2	3
Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
1	80	70
1	85	75
2	75	70
2	85	80
3	85	75
3	80	70

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
L	H	-	H	L	-	-	-	-	L	-	H	-	-	L
M	H	L	M	L	-	-	-	-	L	-	H	-	-	M
M	H	M	H	L	-	-	-	-	L	-	H	-	-	M
M	H	M	H	L	-	-	-	-	L	-	H	-	-	M
H	H	M	H	L	-	-	-	-	L	-	H	-	-	M
L	H	-	H	L	-	-	-	-	L	-	H	-	-	L

Duration (hour)	15	15	15	15	15	
S-1	SLO-1	Introduction-Streaming Data	Introduction: Distributed data flow management	Introduction: Distributed stream data processing	Introduction: Storing of stream data	Introduction: Visualizing stream data
	SLO-2	Difference between Streaming Data and Static Data.	Need of message queuing tier	Data processing: partitioning and merges	Purpose of long time storage	Data formats
S-2	SLO-1	Phases in streaming Analytics	Producer, consumer and broker	Coordination , transactions	Direct and indirect writing	Data visualization applications
	SLO-2	Apache Zoo keeper Introduction	Message delivery semantics	Processing data with STORM	In memory storage techniques	Components
S-3	SLO-1	Service configuration and management	Kafka: architecture	Components of storm	NOSQL Introduction	Streaming Dashboard

Duration (hour)	15	15	15	15	15	
	SLO-2	Case study and demo discussions of various domains: Web, mobile app, social network, financial trading, connecting devices	Case study and demo discussions of Kafka data ingestion in various applications	Storm Configuration	Procedures of NOSQL	Case study on visualizing streaming data
S4-5	SLO-1 SLO-2	Lab 1: Implementation of zoo keeper	Lab4 :Implementation of Kafka_messaging data	Lab 7 :Implementation of STORM	Lab10: Implementation of Mongo DB: variables and declarations	Lab 13: Streaming dash board visualization
S-6	SLO-1	Fault tolerance	Security	Local and distributed cluster management	MongoDB: environment, data modelling	Data pipeline visualization
	SLO-2	Hybrid message logging	Fault tolerance	Storm topologies	Database creation	Adding streaming to web applications
S-7	SLO-1	Understanding in fight data analysis	Applying core concepts to business problems	SPARK_Introduction	Creating and dropping collections, data types	HTML 5 canvas
	SLO-2	Distributed stream processing framework	Algorithms for data analysis overview	RDD architecture	Insert ,delete and update document	Inline SVG
S-8	SLO-1	Key features of stream processing framework	Sliding window technique	Applications of Spark streaming	Mongo DB projection	Data Driven Document (D3) introduction
	SLO-2	Case study: selection of best node in application development	Case study and discussions on other messaging systems	Case study and demo discussion of spark streaming	Limiting and sorting records	Case study discussions of various visualizing tools
S9-10	SLO-1 SLO-2	Lab 2: Implementation of leader election problem	Lab 5: Implementation of flume	Lab 8: Implementation of SPARK	Lab 11:Implementation of Database creation: documents updation	Lab 14 :HTML canvas, D3 js
S-11	SLO-1	Z node creation	Tumbling window technique	Comparison of other stream processing techniques	Indexing	High level tools
	SLO-2	Watches and notifications	Random sampling technique	Data processing with Samza	Aggregation	Mobile streaming applicaions
S-12	SLO-1	Overview of Large Scale Stream Processing Engines	Flume: Distributed log collection	Yarn and samza	Sharding and replication	Data visualization through graph representations
	SLO-2	Introduction : Graph concepts	Flume Agent	Integrated samza into data flow	Mongo DB Relationship	High dimensional data visualization
S-13	SLO-1	DAG: stream processing model	Flume data model	Samza jobs	Database references	multivariate data visualization
	SLO-2	Case study to inject data into kafka	Sources and sink	Case study to process stream data	Case study discussion and demo: Mongo DB deployment	Case studies on visualizing data on various fields
S14-15	SLO-1 SLO-2	Lab 3: Implement Kafka command line Interface	Lab 6: Message ingestion through flume	Lab 9: SPARK streaming	Lab 12:Implementation of Mongo DB: Indexing and aggregation	Lab 15 : visualization tool practice: D3.js

Learning Resources	<ol style="list-style-type: none"> 1. Andrew G. Psaltis, "Streaming Data: Understanding the real-time pipeline" Manning Publications, 1st edition, 2017. 2. Byron Ellis, "Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data", Wiley, 1st edition, 2014. 3. Anthony Aragues, "Visualizing Streaming Data: Interactive Analysis Beyond Static Limits ", O'Reilly, 1st Edition, 2018. 4. Bill Franks, "Taming The Big Data Tidal Wave Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley, 2012. 5. Chun-houh, Chen, WolfgangHardle, Antony Unwin, Handbook of Data visualization, Springer, 2008. 6. kafka.apache.org 7. flume.apache.org 8. zookeeper.apache.org 9. spark.apache.org 10. .storm.apache.org
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	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)				#CLA-3 (15%)	Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)			Theory	Practice
		Theory	Practice	Theory	Practice			
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Harisekharan, Freelance consultancy for big data projects	1.Dr.Geetha, Professor, Rajalakshmi Institute of Technology	1. D.Hemavathi, SRMIST
		2. Dr.G.Vadivu, SRMIST
		3.K.Sornalakshmi, SRMIST

Course Code	20ITE612J	Course Name	DEEP LEARNING FOR DATA ANALYTICS	Course Category	E	Professional Elective	L	T	P	C
							3	0	2	4

Pre-requisite Courses	20ITC504J	Co-requisite Courses	Nil	Progressive Courses	
Course Offering Department	Information Technology		Data Book / Codes/Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-1 :	Understand a Mathematical models to build a Deep learning Models.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning	
CLR-2 :	Gain knowledge on basic key concepts of Deep learning				M	M	H	H	M	-	-	-	L	L	-	H	-	-	H	
CLR-3 :	Understand the linear models and stochastic optimization methods for training deep neural networks				M	M	-	M	M	-	-	-	M	L	-	H	-	-	H	
CLR-4 :	Understand the intuition behind Convolutional Neural Networks and Recurrent Neural Networks				M	H	M	H	H	-	-	-	M	L	-	H	-	-	H	
CLR-5 :	Introduce the basic principles of auto encoders				H	H	-	H	M	-	-	-	M	L	-	H	-	-	H	
CLR-6 :	Understand the various deep architectures and applications of computer vision				H	H	H	H	M	-	-	-	L	L	-	H	-	-	H	
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																			
CLO-1 :	Understand the basic concept of linear algebra and able to develop basic Deep neural network model	1	80	70																
CLO-2 :	Apply the knowledge of gradient descent and regularization techniques in feed forward networks	1	85	75																
CLO-3 :	Create a Convolutional neural network for processing high dimensional data like images and Text	2	75	70																
CLO-4 :	Understand the sequence modeling and able to develop Recurrent models	2	85	80																
CLO-5 :	Acquire knowledge of auto encoders	3	85	75																
CLO-6 :	Implement deep neural network for various tasks of computer vision like object detection, image captioning.	3	80	70																

Duration (hour)	15		15		15		15		15	
S-1	SLO-1	Introduction--Machine Learning Basics: Learning Algorithms	Deep feed forward networks- Introduction-	Convolutional Networks - Introduction	Auto encoders - Introduction	Deep Architectures in Vision				
	SLO-2	Supervised and Unsupervised Training	Shallow Neural Network, Deep Neural Network	Motivation	Auto encoder Architecture	Introduction to imagenet and imagenet Large Scale Visual Recognition Challenge (ILSVRC)				
S-2	SLO-1	Linear Algebra for machine Learning	Hyperparameter Tuning, Batch Normalization	Convolutional operation	under complete, regularized auto encoder	Alexnet				
	SLO-2	Dimensionality reduction-Principal Component Analysis-PCA	Learning XOR	Pooling	stochastic, denoising, contractive auto encoder	VGGNet				

Duration (hour)	15	15	15	15	15	
S-3	SLO-1	Over/Under-fitting,	Gradient-Based Learning	Introduction to Normalization	Variational Autoencoders	Resnet
	SLO-2	Cross-Validation - types	Various types of Gradient Descent functions	Various types of Normalization in CNN	Applications of Auto encoders	Googlenet
S4-5	SLO-1	Lab 1: To implement data classification using simple ML algorithm (Revisit)	Lab 4: To build a simple feed forward neural network to recognize handwritten character.(MNIST Dataset)	Lab 7 : To Build a CNN model to classify Cat and dog image	Lab 10: To Perform compression on mnist dataset using auto encoder	Lab 13: To implement a Pre-trained CNN model as a Feature Extractor using Transfer Learning
	SLO-2					
S-6	SLO-1	Hyper parameters Vs Parameters	Back propagation in Deep neural network	Applications in Computer Vision	Optimization for Deep Learning	Transfer learning,
	SLO-2	validation sets - Training set, Test set and validation set	Mathematical derivation to calculate weight updation		Optimization functions	Siamese Networks
S-7	SLO-1	Estimators, Bias, Variance,	Activation Functions	Time Series Data	RMS Prop for RNNs,	CNN-RNN
	SLO-2	Regularization	Linear and non linear Activation	Sequence Modeling:	SGD for CNNs	Applications of CNN-RNN
S-8	SLO-1	Challenges Motivating Deep Learning	Error Functions	Recurrent Neural Networks	Image Compression - introduction	3D CNN
	SLO-2	The Curse of Dimensionality	Maximum likelihood and cross entropy	Difficulty in Training RNN	Difference between Auto Encoders and PCA-its Applications in Image Compression	Applications in video Tasks
S9-10	SLO-1	Lab 2: To implement Planer data classification with a hidden layer	Lab 5: To implement implement different variants of gradient descent algorithm and generate 3D and 2D animation plots.	Lab 8: TO Build a Recurrent Neural Network - Step by Step. (Spam classification, sentiment analysis)	Lab 11: To perform compression on Images (collection of face images) using auto encoders and PCA and compare the results.	Lab 14: To implement 3D CNN to classification of Data (Apply Medical Image Processing)-
	SLO-2					
S-11	SLO-1	Historical Trends in Deep Learning	Architecture Design	LSTM Architecture	Adversarial Generative Networks - Introduction	Metric Learning
	SLO-2	Introduction to a simple DNN	Universal Approximation Properties and Depth	LSTM Applications, RNN VS LSTM	Motivation - why GAN	
S-12	SLO-1	Platform for deep learning	differentiation algorithms	GRU Architecture - Steps - update gate, Reset gate	Generator and Discriminator Functions	Object Detection and Object Localization
	SLO-2	Introduction, requirements to build DNN	First order and second order optimization algorithm	Steps: Current memory content, Final	GAN and Convolution networks	RCNN, Fast RCNN, Faster RCNN- Working and comparison

Duration (hour)		15	15	15	15	15
				memory at current time step		
S-13	SLO-1	Deep learning software libraries	Regularization for Deep learning	Encoder Decoder - introduction	Various GAN - DCGANs, conditional GANs, Pix2Pix, CycleGANs, MaGAN, TextGAN	Object Detection in Video
	SLO-2	Introduction to Tensorflow, Keras, PyTorch	Early Stopping, Drop out.	Architecture and applications	GAN Applications	YOLO Architecture
S14-15	SLO-1	Lab 3: To Build a deep neural network - step by step	Lab 6: To implement gradient descent and backpropagation in deep neural network	Lab 9: TO Build a Recurrent Neural Network - to generate caption from the Scene Images	Lab 12: To Implement a Deep Convolutional GAN to generate complex, color images	Lab 15: To implement a YOLO model to detect object.
	SLO-2					

Learning Resources	1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016 (available at http://www.deeplearningbook.org)	5. Christopher and M. Bishop, "Pattern Recognition and Machine Learning", Springer Science Business Media, 2006.
	2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012	6. Jason Brownlee, "Deep Learning with Python", ebook, 2016
	3. Michael Nielsen, "Neural Networks and Deep Learning", Online book, 2016 (http://neuralnetworksanddeeplearning.com/)	7. N. D. Lewis, "Deep Learning Step by Step with Python: A Very Gentle Introduction to Deep Neural Networks for Practical Data Science"
	4. Li Deng, Dong Yu, "Deep Learning: Methods and Applications", Foundations and Trends in Signal Processing.	

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (60% weightage)					Final Examination (40% weightage)	
		CLA-1 (20%)		CLA-2 (25%)		#CLA-3 (15%)		
		Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember Understand	20%	20%	15%	15%	20%	15%	10%
Level 2	Apply Analyze	20%	20%	15%	15%	40%	20%	20%
Level 3	Evaluate Create	10%	10%	20%	20%	40%	15%	20%
	Total	100 %		100 %		100 %	100 %	

#CLA-3 will be a Self-Learning Component and is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. <i>Mr. Gautham Suriya Mathialagan, Head of Engineering, AI ,ML VR, Anavi smart VR solutions</i>	1. <i>Dr. J. Umarani , IIITDM Kancheepuram</i>	1. <i>Ms. Meenakshi K, Asst. Prof. Department of Information Technology</i>

8. Program Articulation Matrix