SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry

(As per UGC - 2018 Regulations and Affiliated to Pondicherry University)

PUDUCHERRY – 605107

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.TECH.

COMPUTER SCIENCE ENGINEERING (BIG DATA ANALYTICS)

(REGULATIONS - 2023)

CURRICULUM AND SYLLABI

Dr.K.PREMKUMAR
Professor & Head
Dept. of Computer Science and Engg.
Sri Manakula Vinayagar Engg. College
[An Autonomous Institution]

COLLEGE VISION AND MISSION

VISION

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

MISSION

M1: Quality Education : To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation : To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship : To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values : To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

VISION

To create a productive learning and research environment for graduates to become highly dynamic, competent, ethically responsible, professionally knowledgeable in the field of computer science and engineering to meet the industrial needs on par with global standards.

MISSION

M1: Quality Education: Empowering the students with the necessary technical skills through quality education to grow professionally.

M2: Innovative Research: Advocating the innovative research ideas by incorporating with industries for developing products and services.

M3: Placement and Entrepreneurship: Advancing the education by strengthening the Industry-academic relationship through hands-on training to seek placement in the top most industries or to develop a start-ups.

M4: Ethics and Social Responsibilities: Stimulating professional behaviour and good ethical values to improve the leadership skills and social responsibilities.

PROGRAMME OUTCOMES (POs)

PO1: Exploration of Research:

An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Technical Skill:

An ability to write and present a substantial technical report/document.

PO3: Expertise in Academics:

Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Problem solving:

An ability to discriminate, analyzes, evaluate and synthesize the technologies to provide solution for multidimensional engineering problems.

PO5: Usage of Modern Tools:

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations..

PO6: Ethical Practices and Social Responsibility:

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical Knowledge: To acquire a comprehensive knowledge in computer science engineering concepts and apply them for the investigation of real world problems.

PEO2: Research and Development: To prepare graduates who will demonstrate analytical, research, design and implementation skills offering techno-commercially feasible and socially acceptable solutions.

PEO3: Leadership: To prepare graduates who will demonstrate analytical, research, design and implementation skills offering techno-commercially feasible and socially acceptable solutions

PEO4: Professional Behavior: To deliver graduates to design and implement solutions for rapidly changing computing problems and information system environments to adapt innovation.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Technical Knowledge in Computer Science and Engineering: Graduates with the ability to apply basic knowledge of Computer Science in solving the critical problems.

PSO2: Multidisciplinary Competency: Ability to convert innovative ideas into research or society oriented projects through current trending technologies.

PSO3: Employability: Acquire placement in highly reputed industries or accomplish new technical business skills with the contemporary trends in the industry.

STRUCTURE FOR POST GRADUATE ENGINEERING PROGRAM

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	6
2	Basic Sciences(BS)	3
3	Engineering Sciences (ES)	-
4	Professional Core (PC)	25
5	Professional Electives (PE)	18
6	Open Electives (OE)	-
7	Project Work and Internship(PA)	20
8	Ability Enhancement Courses (AEC)	-
9	Mandatory courses (MC)	-
Total		**72**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	Course Category	Credits per Semester				Total Credits
		I	II	III	IV	
1	Humanities and Social Sciences (HS)	4	2	-	-	6
2	Basic Sciences(BS)	3	-	-	-	3
3	Engineering Sciences (ES)	-	-	-	-	-
4	Professional Core (PC)	11	14	-	-	25
5	Professional Electives (PE)	3	6	9	-	18
6	Open Electives (OE)	-	-	-	-	-
7	Project Work and Internship(PA)			8	12	20
8	Ability Enhancement Courses (AEC)*	-	-	-	-	-
9	Mandatory Courses (MC)*	-	-	-	-	-
Total		**21**	**22**	**17**	**12**	**72**

**** AEC, MC Credits are not included for CGPA calculation***

CURRICULUM

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23MAT104	Mathematical Foundations for Data Analytics	BS	3	0	0	3	40	60	100
2	P23BDT101	Big Data Acquisition	PC	3	0	0	3	40	60	100
3	P23BDT102	Exploratory Data Analysis	PC	3	0	0	3	40	60	100
4	P23BDT103	Big Data Frameworks	PC	3	0	0	3	40	60	100
5	P23HSTC01	Research Methodology and IPR	HS	2	0	0	2	40	60	100
6	P23BDE1XX	Professional Elective - I *	PE	3	0	0	3	40	60	100
Practical										
7	P23BDP101	Big Data Computing Laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC01	Technical Report Writing and Seminar	HS	0	0	4	2	100	-	100
Ability Enhancement Course										
9	P23CSC1XX	Certification Course-I #	AEC	0	0	4	-	100	-	100
10	P23ACT10X	Audit Course-I**	AEC	0	0	2	-	100	-	100
							21	590	410	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23BDT204	Mining Massive Data	PC	3	0	0	3	40	60	100
2	P23BDT205	Streaming Data Analytics	PC	3	0	0	3	40	60	100
3	P23BDT206	Big Data with SQL	PC	3	0	0	3	40	60	100
4	P23BDTD01	No SQL Databases	PC	3	0	0	3	40	60	100
5	P23BDE2XX	Professional Elective - II*	PE	3	0	0	3	40	60	100
6	P23BDE2XX	Professional Elective - III*	PE	3	0	0	3	40	60	100
Practical										
7	P23BDP202	Big Data with SQL Laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC02	Seminar on ICT a hands on approach	HS	0	0	4	2	100	-	100
Ability Enhancement Course										
9	P23BDC2XX	Certification Course-II #	AEC	0	0	4	-	100	-	100
10	P23ACT20X	Audit Course-II**	AEC	0	0	2	-	100	-	100
							22	590	410	1000

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23BDE3XX	Professional Elective – IV *	PE	3	0	0	3	40	60	100
2	P23BDE3XX	Professional Elective – V *	PE	3	0	0	3	40	60	100
3	P23BDE3XX	Professional Elective – VI *	PE	3	0	0	3	40	60	100
Project Work										
4	P23BDW301	Project Phase – I	PA	0	0	12	6	50	50	100
5	P23BDW302	Internship	PA	0	0	0	2	100	-	100
Ability Enhancement Course										
6	P23BDC301	NPTEL/SWAYAM/MOOC	AEC	0	0	0	-	100	-	100
							17	370	230	600

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Project Work										
1	P23BDW403	Project Phase – II	PA	0	0	24	12	50	50	100
							12	50	50	100

*** Professional Elective Courses are to be selected from the list given in Annexure I**
 # Ability Enhancement Courses are to be selected from the list given in Annexure II
**** Audit Courses are to be selected from the list given in Annexure III**

BS- Basic Sciences

PC – Professional Core

PE – Professional Elective

HS - Humanities and Social Sciences

PA - Professional Activity

CC- Common Course

AC- Audit Course

AEC - Ability Enhancement Course

CREDIT DISTRIBUTION

Semester	I	II	III	IV	Total
Credits	21	22	17	12	72

Total number of credits required to complete
M.Tech in Computer Science and Engineering : 72 credits

ANNEXURE- I
PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title
Professional Elective-I		
1	**P23BDE101**	Data Driven Decision Making
2	**P23BDEC01**	Neural Networks
3	**P23BDE102**	Multicore Architectures
4	**P23CSTD01**	Advanced Data Structures and Algorithms
5	**P23BDE103**	Machine Learning
Professional Elective-II		
1	**P23CSEC01**	Information Visualization
2	**P23CSEC03**	Text, Web and Social Media Analytics
3	**P23CSTD02**	Speech and Language Processing
4	**P23BDEC02**	Web Analytics and Development
5	**P23BDE204**	Expert System and Decision Making
Professional Elective-III		
1	**P23BDE205**	Information Retrieval
2	**P23BDE206**	Supply Chain Analytics
3	**P23BDE207**	Cryptography and Information Security
4	**P23BDE208**	Semantic Web and Knowledge Management
5	**P23BDE209**	Artificial Intelligence
Professional Elective-IV		
1	**P23BDE310**	Optimization Techniques for Analytics
2	**P23CSEC04**	Data Storage Technologies and Networks
3	**P23BDE311**	Models of Computation
4	**P23CSEC02**	Soft Computing
5	**P23BDE312**	Deep Learning
Professional Elective-V		
1	**P23BDE313**	Blockchain Technology
2	**P23BDE314**	Speech Recognition
3	**P23ADEC01**	Agile and Software Project Management
4	**P23CSEC05**	Game Design and Augmented Reality
5	**P23CSEC06**	Image and Video Analytics
Professional Elective-VI		
1	**P23BDE315**	Graphs – Algorithms and Mining
2	**P23BDE316**	Real-Time Systems
3	**P23BDE317**	Social Network Analysis
4	**P23BDE318**	Analytics of Things
5	**P23BDE319**	User Interface/ User Experience Design

ANNEXURE- II

ABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Course Title
1	P23XXCX01	Adobe Photoshop
2	P23XXCX02	Adobe Animate
3	P23XXCX03	Adobe Dreamweaver
4	P23XXCX04	Adobe After Effects
5	P23XXCX05	Adobe Illustrator
6	P23XXCX06	Adobe InDesign
7	P23XXCX07	Autodesk AutoCAD -ACU
8	P23XXCX08	Autodesk Inventor – ACU
9	P23XXCX09	Autodesk Revit – ACU
10	P23XXCX10	Autodesk Fusion 360 – ACU
11	P23XXCX11	Autodesk 3ds Max – ACU
12	P23XXCX12	Autodesk Maya – ACU
13	P23XXCX13	Cloud Security Foundations
14	P23XXCX14	Cloud Computing Architecture
15	P23XXCX15	Cloud Foundation
16	P23XXCX16	Cloud Practitioner
17	P23XXCX17	Cloud Solution Architect
18	P23XXCX18	Data Engineering
19	P23XXCX19	Machine Learning Foundation
20	P23XXCX20	Robotic Process Automation / Medical Robotics
21	P23XXCX21	Advance Programming Using C
22	P23XXCX22	Advance Programming Using C ++
23	P23XXCX23	C Programming
24	P23XXCX24	C++ Programming
25	P23XXCX25	CCNP Enterprise: Advanced Routing
26	P23XXCX26	CCNP Enterprise: Core Networking
27	P23XXCX27	Cisco Certified Network Associate - Level 2
28	P23XXCX28	Cisco Certified Network Associate- Level 1
29	P23XXCX29	Cisco Certified Network Associate- Level 3
30	P23XXCX30	Fundamentals Of Internet of Things
31	P23XXCX31	Internet Of Things / Solar and Smart Energy System with IoT
32	P23XXCX32	Java Script Programming
33	P23XXCX33	NGD Linux Essentials

34	P23XXCX34	NGD Linux I
35	P23XXCX35	NGD Linux II
36	P23XXCX36	Advance Java Programming
37	P23XXCX37	Android Programming / Android Medical App Development
38	P23XXCX38	Angular JS
39	P23XXCX39	Catia
40	P23XXCX40	Communication Skills for Business
41	P23XXCX41	Coral Draw
42	P23XXCX42	Data Science Using R
43	P23XXCX43	Digital Marketing
44	P23XXCX44	Embedded System Using C
45	P23XXCX45	Embedded System with IOT / Arduino
46	P23XXCX46	English For IT
47	P23XXCX47	Plaxis
48	P23XXCX48	Sketch Up
49	P23XXCX49	Financial Planning, Banking and Investment Management
50	P23XXCX50	Foundation Of Stock Market Investing
51	P23XXCX51	Machine Learning / Machine Learning for Medical Diagnosis
52	P23XXCX52	IOT Using Python
53	P23XXCX53	Creo (Modelling & Simulation)
54	P23XXCX54	Soft Skills, Verbal, Aptitude
55	P23XXCX55	Software Testing
56	P23XXCX56	MX-Road
57	P23XXCX57	CLO 3D
58	P23XXCX58	Solid works
59	P23XXCX59	Staad Pro
60	P23XXCX60	Total Station
61	P23XXCX61	Hydraulic Automation
62	P23XXCX62	Industrial Automation
63	P23XXCX63	Pneumatics Automation
64	P23XXCX64	Agile Methodologies
65	P23XXCX65	Block Chain
66	P23XXCX66	Devops
67	P23XXCX67	Artificial Intelligence
68	P23XXCX68	Cloud Computing
69	P23XXCX69	Computational Thinking

70	P23XXCX70	Cyber Security
71	P23XXCX71	Data Analytics
72	P23XXCX72	Databases
73	P23XXCX73	Java Programming
74	P23XXCX74	Networking
75	P23XXCX75	Python Programming
76	P23XXCX76	Web Application Development (HTML, CSS, JS)
77	P23XXCX77	Network Security
78	P23XXCX78	MATLAB
79	P23XXCX79	Azure Fundamentals
80	P23XXCX80	Azure AI (AI-900)
81	P23XXCX81	Azure Data (DP -900)
82	P23XXCX82	Microsoft 365 Fundamentals (SS-900)
83	P23XXCX83	Microsoft Security, Compliance and Identity (SC-900)
84	P23XXCX84	Microsoft Power Platform (PI-900)
85	P23XXCX85	Microsoft Dynamics Fundamentals 365 – CRM
86	P23XXCX86	Microsoft Excel
87	P23XXCX87	Microsoft Excel Expert
88	P23XXCX88	Securities Market Foundation
89	P23XXCX89	Derivatives Equinity
90	P23XXCX90	Research Analyst
91	P23XXCX91	Portfolio Management Services
92	P23XXCX92	Cyber Security
93	P23XXCX93	Cloud Security
94	P23XXCX94	PMI – Ready
95	P23XXCX95	Tally – GST & TDS
96	P23XXCX96	Advance Tally
97	P23XXCX97	Associate Artist
98	P23XXCX98	Certified Unity Programming
99	P23XXCX99	VR Development

ANNEXURE-III

AUDIT COURSES
(Common to all M.Tech Programme)

Sl. No.	Course Code	Course Title
1	P23ACTX01	English for Research Paper Writing
2	P23ACTX02	Disaster Management
3	P23ACTX03	Sanskrit for Technical Knowledge
4	P23ACTX04	Value Education
5	P23ACTX05	Constitution of India
6	P23ACTX06	Pedagogy Studies
7	P23ACTX07	Stress Management by Yoga
8	P23ACTX08	Personality Development Through Life Enlightenment Skills
9	P23ACTX09	Unnat Bharat Abhiyan

Department	**Computer Science Engineering (BigData Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **BS**			*End Semester Exam Type: **TE**			
Course Code	**P23MAT104**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Mathematical Foundations for Data Analytics**	**3**	**1**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basic Mathematics	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Basic knowledge of matrix, set theory, functions and relations concepts needed for designing and solving problems.	**K1**
	CO2 Design and solve Boolean functions for defined problems.	**K4**
	CO3 Apply the concept of testing of hypothesis for small and large samples in real lifeproblems.	**K1**
	CO4 Concept of linear regression, correlation, and its applications	**K3**
	CO5 List the guidelines for designing experiments and recognize the key historical figuresin Design of Experiments.	**K3**

UNIT- I	**Matrix Algebra**	**Periods: 9**	
Matrices - Rank of a matrix - Solving system of equations – Eigen values and Eigenvectors - Cayley - Hamilton theorem -Inverse of a matrix.			**CO1**
UNIT- II	**Mathematical logic**	**Periods:9**	
Propositions and logical operators - Truth table - Propositions generated by a set - Equivalence and implication -Basic laws - Some more connectives - Functionally complete set of connectives - Normal forms.			**CO2**
UNIT- III	**Testing of hypothesis**	**Periods:9**	
Sampling distributions – Small and large samples –Tests based on Normal, t test, Chi square test,andF test distributions for testing of means, variance and proportions — Contingency table (test fo independent) Goodness. of fit.			**CO3**
UNIT- IV	**Correlation and regression**	**Periods:9**	
Correlation –Rank correlation– Regression –Multiple and partial correlation – Method of least squares –Plane of regression – Coefficient of multiple correlation – Coefficient of partial correlation.			**CO4**
UNIT- V	**Design of experiments**	**Periods:9**	
Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design –Latin square design - 2^2 Factorial design.			**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. David Makinson, “Sets, Logic and Maths for Computing”, Springer Indian Reprint, 2011.
2. Grimaldi, R.P and Ramana, B.V. "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2006.
3. C W. Evans, “Engineering Mathematics”, A Programmed Approach, 3rd Edition, 2019.

Reference Books

1. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, Tata McGraw Hill, 4th Edition, 2002.
2. Sengadir, T. “Discrete Mathematics and Combinatorics" Pearson Education, New Delhi, 2009.
3. Trembley, J.P. and Manohar, R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2007.
4. Venkataraman, M.K., “Engineering Mathematics”, Volume-II, National Publishing Company, Second Edition, 1989.
5. Dr. A. Singaravelu, “Engineering Mathematics - I”, Meenakshi publications, Tamil Nadu, 2019.

Web References

1. https://sites.math.northwestern.edu/~mlerma/courses/cs310-05s/
2. https://csd.cs.cmu.edu/course-profiles/15-151-Mathematical-Foundations-for-Computer-Science
3. https://www.coursera.org/learn/mathematics-for-computer-science
4. https://www.cse.iitb.ac.in/~supratik/courses/cs719/index.html
5. https://www.irif.fr/~jep/PDF/MPRI/MPRI.pd

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	2	1
2	3	2	1	1	-	1	2	2	1
3	3	2	1	1	-	1	2	2	1
4	3	2	1	1	-	-	2	2	1
5	3	2	1	1	-	-	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDT101**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Big Data Acquisition**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand Big Data Acquisition	**K2**
	CO2 Able to collect and store Big Data from various sources	**K4**
	CO3 Make use of Pig Scripts- Extract, Transform and Load the data on HDFS	**K3**
	CO4 Able to write Hive Scripts- Extract, Transform, Load and Analyze the data present in HDFS	**K3**
	CO5 Able to extract and process semi and un-structured data using HBase	**K4**

UNIT- I	**Introduction to Big Data Acquisition**	**Periods:9**	
Big data framework – fundamental concepts of Big Data Management and analytics – Current challenges and trends in Big Data Acquisition-. Map Reduce Algorithm- Hadoop Storage [HDFS], Common Hadoop Shell commands - Anatomy of File Write and Read, Name Node, Secondary Name Node, and Data Node - Hadoop Configuration – Pig Configuration – Hive Configuration – Hbase Configuration.			**CO1**
UNIT- II	**Data Collection and Transmission**	**Periods:9**	
Big data collection – Strategies – Types of Data Sources – Structured Vs Unstructured data – ELT vs ETL – storage infrastructure requirements – Collection methods – Log files – sensors – Methods for acquiring network data (Libcap-based and zero-copy packet capture technology) – Specialized network monitoring softwares (Wireshark, Smartsniff and Winnetcap) – Mobile equipments, Transmission methods, Issues.			**CO2**
UNIT- III	**Introduction to Apache Pig**	**Periods:9**	
Introduction - Pig features - Pig Architecture - Pig Execution modes, Pig Grunt shell and Shell commands. Pig Latin Basics: Data model, Data Types, Operators – Pig Latin Commands - Load & Store , Diagnostic Operators, Grouping, Cogroup, Joining, Filtering, Sorting, Splitting - Built-In Functions, User define functions. Pig Execution Modes: Batch Mode – Embedded Mode – Pig Execution in Batch Mode –Use cases - Map Reduce programs with Pig – Pig Vs SQL			**CO3**
UNIT- IV	**Hive and HiveQL**	**Periods:9**	
Introduction - Hive Features - Hive architecture -Hive Meta store - Hive data types - Hive Tables - Table types - Creating database, Altering database, Create table, alter table, Drop table, Built-In Functions - Built- In Operators, User defined functions(UDFs), View, Pig Vs Hive. HiveQL–Introduction, HiveQL Select, HiveQL – MapReduce using HiveQL OrderBy Group By Joins, LIMIT, Distribute By , Cluster By - Sorting And Aggregation – Partitioning: Static & Dynamic partitioning – Index Creation - Bucketing – Analysis of MapReduce execution – Hive Optimization – Setting Hivng Parameters. Comparison between MapReduce, Hive QL and SQL. UseCase: Implementation of Map Reduce programs with HiveQL.			**CO4**
UNIT- V	**HBase and its Features**	**Periods:9**	
HBasics, Features of HBase, Concepts, Clients, Example, Hbase Versus RDBMS, Limitations of HBase Big Data Privacy And Applications: Data Masking – Privately identified Information (PII) – Privacy preservation in Big Data – Popular Big Data Techniques and tools –ApplicationsSocial Media Analytics – Fraud Detection.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Philip Russom, Colin White, and Ted Friedman, "Data Warehousing in the Age of Big Data", Morgan Kaufmann, 1st edition, 2013.
2. Kuan-Ching Li, Hai Jiang, and Albert Y. Zomaya, "Big Data: Algorithms, Analytics, and Applications" CRC Press, 1st edition, 2015.
3. Martin Atzmueller and Andreas Hotho, "Big Data Analytics: From Strategic Planning to Enterprise Integration withTools, Tech-niques,NoSQL, and Graph", Morgan Kaufmann, 1st edition, 2015
4. Martin Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and MaintainableSystems", O'ReillyMedia, 1st edition, 2017.

Reference Books

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Aplications”, John Wiley & Sons, 2014.
2. Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
3. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
4. Min Chen. Shiwen Mao, Yin Zhang. Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.

5. Michael Minelli, Michele Chambers Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013.

Web References

1. https://www.dataschool.io/
2. https://www.datascamp.com/
3. https://www.kaggle.com/
4. https://towardsdatascience.com/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	1	2	2	3	2	2
2	1	2	2	2	2	2	3	2	2
3	2	3	3	1	3	3	3	3	3
4	2	3	3	1	3	3	3	3	3
5	2	3	3	1	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer ScienceEngineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDT102**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Exploratory Data Analysis**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Handle missing data in the real-world data sets by choosing appropriate methods.	**K3**
	CO2 Summarize the data using basic statistics. Visualize the data using basic graphsand plots.	**K3**
	CO3 Identify the outliers if any in the data set.	**K2**
	CO4 Choose appropriate feature selection and dimensionality reduction.	**K3**
	CO5 Apply Techniques for handling multi-dimensional data.	**K3**

UNIT – I	**Introduction To Exploratory Data Analysis**	**Periods:9**	
Introduction to Exploratory Data Analysis (EDA) - Data Analytics lifecycle- Definition, Motivation, Steps in data exploration- Data Types: Numerical Data – Discrete data, continuous data – Categorical data – Measurement Scales: Nominal, Ordinal, Interval, Ratio – Comparing EDA with classical andBayesian Analysis – Software tools for EDA.			**CO1**
UNIT – II	**Data Transformation, Correlation Analysis andTime Series Analysis**	**Periods:9**	
Transformation Techniques: Performing data deduplication - replacing values – Discretizationand binning. Introduction to Missing data, handling missing data: Traditional methods - MaximumLikelihood Estimation. Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data - resampling time series data.			**CO2**
UNIT – III	**Data Summarization and Visualization**	**Periods:9**	
Statistical summary measures, data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, contingency tables, n-D Statistical data analysis. Visualization: Scatter plots – Dot charts - Bar plots.			**CO3**
UNIT – IV	**Clustering Algorithms and Dimensionality Reduction**	**Periods:9**	
Introduction to Spectral clustering – Document clustering – Minimum Spanning Tree clustering. Overview of Model- based clustering – Expectation-Maximization algorithm – Hierarchical Agglomerative model-based clustering. Outlier detection using Clustering. Principal Component Analysis (PCA) – Singular Value Decomposition – Factor Analysis -Intrinsic Dimensionality.Non Linear methods: Multidimensional Scaling – Manifold Learning – Self-Organizing Maps.			**CO4**
UNIT – V	**Model Development and Evaluation**	**Periods:9**	
Statistical summary measures, data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, contingency tables, n-D Statistical data analysis. Visualization: Scatter plots – Dot charts -Bar plots.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python” 1st Edition, 2020, Packt Publishing.
2. Martinez, W , Martinez A & J.L. Solka : Exploratory Data Analysis with MATLAB, CRC Press, A Chapman & HallBook, 3rd Edition, 2017
3. Foster Provost and Tom Fawcett, “Data Science for Business", 1st Edition, 2013

Reference Books

1. Michael Jambu, “Exploratory and multivariate data analysis”, 1991, 1st Edition, Academic Press Inc.
2. Charu C. Aggarwal, “Data Mining The Text book”, 2015, Springer.
3. Craig K. Enders, “Applied Missing Data Analysis”, 2010, 1st Edition, The Guilford Press
4. Kieran Healy , "Data Visualization: A Practical Introduction"1st Edition, 2018
5. Alex Reinhart , "Statistics Done Wrong", 1st Edition, 2015

Web References

1. https://www.dataschool.io/
2. https://www.datascamp.com/
3. https://www.kaggle.com/
4. https://towardsdatascience.com/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	2	2	1	-	1	3	-
2	1	1	2	2	1	2	1	-	3
3	2	1	1	2	1	2	1	3	-
4	3	1	2	1	-	1	-	3	1
5	3	1	1	2	-	-	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering(Big Data Analytics)**	Programme : **M.Tech.**						
Semester	**I**	Course Category :**PC**			*End SemesterExamType:**TE**			
Course Code	**P23BDT103**	Periods/Week			Credit	MaximumMarks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Big Data Frameworks**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Big Data	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Discuss the challenges and their solutions in Big Data.	**K2**
	CO2 Understand and work on Hadoop Framework and eco systems.	**K2**
	CO3 Analyze the Big Data using Map-reduce programming in both Hadoop and Spark framework.	**K3**
	CO4 Demonstrate spark programming with different programming languages.	**K3**
	CO5 Demonstrate the graph algorithms and live streaming data in Spark.	**K3**

UNIT- I	**Introduction to Big Data**	**Periods:9**	
Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Needof big dataframeworks.			**CO1**
UNIT- II	**Hadoop Ecosystem**	**Periods:9**	
Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with othe system - Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands Map Reduce Programming: I/O formats Map side join, Reduce Side Join, Secondary sorting, Pipelining Map Reduce jobs, Hadoop ecosystem technologies Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm.			**CO2**
UNIT- III	**Spark Framework**	**Periods:9**	
Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDAMemory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features- Introduction to spark, Spark architecture and Componenets semantic web .			**CO3**
UNIT- IV	**Data Analysis with Spark Shell**	**Periods:9**	
Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution. SQLContext – Importingand Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms.			**CO4**
UNIT- V	**Spark Streaming**	**Periods:9**	
Overview – Transformation Operations in Spark, Spark Streaming Architecture, Errors and Recovery – Streaming Source – Streaming live data with spark			**CO5**

LecturePeriods:45	**TutorialPeriods:-**	**PracticalPeriods:-**	**TotalPeriods:45**

Text Books

1. Viktor Mayer-Schönberger and Kenneth Cukier,"Big Data: A Revolution That Will Transform How We Live, Work, and Think" Houghton Mifflin Harcourt, 2013
2. Nathan Marz and JamesWarren, "Big Data: Principles and Best Practices of Scalable Realtime Data Systems", Manning Publications, 2015
3. Bill Chambers and Matei Zaharia,"Spark: The Definitive Guide" O'Reilly Media Year: 2018

Reference Books

1. Mike Frampton, "Mastering Apache Spark", Packt Publishing,2015.
2. TomWhite,"Hadoop:TheDefinitiveGuide",O'Reilly,4thEdition,2015.
3. Nick Pentreath, Machine Learning with Spark, Packt Publishing, 2015.
4. Mohammed Guller, Big Data Analytics with Spark, Apress,2015
5. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012.

Web References

1. https://hadoop.apache.org/
2. https://spark.apache.org/
3. https://flink.apache.org/
4. https://storm.apache.org/
5. https://kafka.apache.org/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	3	3	2	2	2	2
2	2	3	3	3	2	1	2	2	1
3	2	3	3	2	1	-	2	2	1
4	2	2	3	2	3	2	2	3	1
5	3	2	2	3	3	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **HS**			*End Semester Exam Type: **TE**			
Course Code	**P23HSTC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Research Methodology and IPR**	**2**	**-**	**-**	**2**	**40**	**60**	**100**

(Common to all M.Tech Courses)

Prerequisite	No prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Gain Knowledge to formulate the research problem.	**K2**
	CO2 Understand the concepts to carry out the literature review, ethics and research analysis.	**K2**
	CO3 Explain the way of writing technical paper and presentation methods.	**K2**
	CO4 Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	**K2**
	CO5 Ability to understand about IPR and filing patents in R & D.	**K3**

UNIT- I	**Research Problem Formulation**	**Periods: 6**	
Meaning of research problem- Sources of research problem - criteria characteristics of a good research problem - errors in selecting a research problem - scope and objectives of research problem. Approaches of investigation of solutions for research problem - data collection – analysis – interpretation - necessary instrumentations.			**CO1**
UNIT- II	**Literature Review**	**Periods: 6**	
Effective literature studies approaches – analysis – plagiarism and research ethics			**CO2**
UNIT- III	**Technical Writing /Presentation**	**Periods: 6**	
Effective technical writing - how to write report – paper - developing a research proposal - format of research proposal - Presentation and assessment by a review committee.			**CO3**
UNIT- IV	**Introduction To Intellectual Property Rights (IPR)**	**Periods: 6**	
Nature of Intellectual Property: Patents – Designs - Trade and Copyright. Process of Patenting and Development: Technological research – innovation – patenting - development. International Scenario: International cooperation on Intellectual Property - Procedure for grants of patents - Patenting under PCT.			**CO4**
UNIT- V	**Intellectual Property Rights (IPR)**	**Periods: 6**	
Patent Rights: Scope of Patent Rights - Licensing and transfer of technology - Patent information and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - IPR of Biological Systems - Computer Software etc. Traditional knowledge Case Studies - IPR and IITs.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Text Books

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & Engineering students', Kenwyn Publisher, 1996.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Lansdowne Publisher, Second Edition, 2001.
3. C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, Fourth Edition, 2018.

Reference Books

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Limited, 2007.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", Second Edition, 2010.
3. Trochim, "Research Methods: The concise knowledge base", Atomic Dog Publishing, 2005.
4. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

Web References

1. https://www.scribd.com/document/427419672/Research-Methodology-and-Ipr
2. https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf
3. https://www.wipo.int/edocs/pubdocs/en/intproperty/958/wipo_pub_958_3.pdf
4. https://lecturenotes.in/m/21513-research-methodology
5. https://iare.ac.in/sites/default/files/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	3	3	2
2	3	2	1	1	2	1	3	2	2
3	3	2	1	1	2	1	3	2	2
4	3	2	1	1	3	1	3	2	3
5	3	2	1	1	2	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering(Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **LE**			
Course Code	**P23BDP101**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Big Data Computing Laboratory**	**-**	**-**	**4**	**1**	**50**	**50**	**100**

Prerequisite	Basics of Big Data	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Configure Hadoop and perform File Management Tasks.	**K2**
	CO2 Apply MapReduce programs to real time issues like word count, weather dataset and sales of a company.	**K3**
	CO3 Critically analyze huge data set using Hadoop distributed file systems and MapReduce.	**K2**
	CO4 Apply different data processing tools like Pig, Hive and Spark.	**K3**
	CO5 To validate and analysis the data computing.	**K4**

List of Experiments:

1. Develop a MapReduce program to calculate the frequency of a given word in agiven file.
2. Develop a MapReduce program to find the maximum temperature in each year.
3. Develop a MapReduce program to find the grades of student's.
4. Develop a MapReduce program to implement Matrix Multiplication.
5. Develop a MapReduce to find the maximum electrical consumption in each year givenelectrical consumption for each month in each year.
6. Develop a MapReduce to analyze weather data set and print whether the dayis shinny or coolday.
7. Develop a MapReduce program to find the number of products sold ineach countryby considering sales data containing fields like Tranction _Date Product Price Payment_Type Name City\State CountryAccount_Created Last_Login Latitude Longitude
8. Develop a MapReduce program to find the tags associated with each movie byanalyzingmovie lens data.
9. XYZ.com is an online music website where users listen to various tracks, the data gets collected whichis given below. The data is coming in log files and looks like as shown below.UserId | TrackId | Shared | Radio | Skip

   111115 | 222 | 0 | 1 | 0

   111113 | 225 | 1 | 0 | 0

   111117 | 223 | 0 | 1 | 1
   111115 | 225 | 1 | 0 | 0
10. Write a MapReduce Number of unique listeners.
    Number of times the track was shared with others
    Number of times the track was listened to on the radio
    Number of times the track was listened to in total
    Number of times the track was skipped on the radio
11. Develop a MapReduce program to find the frequency of books published eachyear and find in which year maximum number of books were published using the following data. Title Author Published year Author country Language No of pages
12. Develop a MapReduce program to analyze Uber data set to find the days on which each basement has more trips using the following dataset. The Uber dataset consists of four columns they aredispatching_base_number date active vehicles trips
13. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset inPig Latin
14. Write queries to sort and aggregate the data in a table using HiveQL.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'reilly Media, 2015
2. Glenn J. Myatt, "Making Sense of Data" , John Wiley & Sons, 2007
3. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
4. Michael Berthold, David J.Hand, "Intelligent Data Analysis", Spingers, 2007.
5. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Uderstanding Big Data : Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing,2012.

Web References

1. https://hadoop.apache.org/
2. https://spark.apache.org/
3. https://flink.apache.org/
4. https://storm.apache.org/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	3	2	2	3	2	2
2	1	2	2	2	2	2	3	2	2
3	1	3	3	3	3	3	3	3	3
4	2	3	3	3	3	3	3	3	3
5	1	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **HS**			*End Semester Exam Type: **LE**			
Course Code	**P23HSPC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Technical Report Writing and Seminar**	**-**	**-**	**4**	**2**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Select a subject, narrowing the subject into a topic.	**K2**
	CO2 State an objective and collecting the relevant bibliography (at least 15 journal papers).	**K2**
	CO3 Study the papers and understanding the author's contributions and critically analyzing each paper.	**K3**
	CO4 Prepare a working outline and linking the papers and preparing a draft of the paper.	**K2**
	CO5 Prepare a working outline and linking the papers and preparing a draft of the paper.	**K2**

List of Experiments:

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic	Select an area of interest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			
Collecting Information about area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	3% (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filte	□ provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar □ When picking papers to read - try to: - Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them. - Favour papers from well-known journals and conferences, in the field (as indicated in other Favour more recent papers, - Pick a recent survey of the field so you can quickly gain an overview, Find relationships with respect to each other and to your topic area(classification scheme/categorization) - Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	6% (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process For each paper form a Table answering the following questions: □ What is the main topic of the article? □ What was/were the main issue(s) the author said they want to discuss? □ Why did the author claim it was important? □ What simplifying assumptions does the author claim to be making? □ What did the author do? □ How did the author claim they were going to evaluate their work and compare it to others? □ What did the author say were the limitations of their research?	6th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	□ What did the author say were the important directions for future research? □ Conclude with limitations/issues not addressed by the paper (from the perspective of survey)		
Reading and notes for next 5 papers	Repeat Reading Paper Process	7 th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8 th week	8% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9 th week	6%(Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11th week	10% (this component will be evaluated based on the linking and classification among the papers)
Conclusions	Write your conclusions and future work	12th week	5% (conclusions)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Repor
Seminar	A brief 15 slides on your paper	14th & 15th week	10% (based on presentation and Vivavoce)
Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:** 45	**Total Periods: 45**

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	3	3	1	3	3	2	1	2
2	2	3	2	1	3	2	2	1	2
3	2	3	2	1	3	2	2	1	2
4	2	3	2	1	3	2	2	1	2
5	2	3	2	1	3	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				Attendance	End Semester Examination (ESE) Marks	Total Marks
	Weekly Progress	Seminar	Record work	Viva			
Marks	40	30	10	10	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **AEC**			*End Semester Exam Type: **-**			
Course Code	**P23CSC1XX**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Ability Enhancement Courses**	**-**	**-**	**4**	**-**	**100**	**-**	**100**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDT204**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Mining Massive Data**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Recollecting fundamentals of data mining.	**K3**
	CO2 Apply the concept of Map reduce and data streams for storing and processing ofmassive data sets.	**K3**
	CO3 Analyze the issues underlying the effective applications of massive datasets.	**K3**
	CO4 Evaluate different clustering algorithms and analyze variousdecomposition techniques.	**K3**
	CO5 Make use of Clustering techniques	**K3**

UNIT- I	**Data Mining**	**Periods:9**	
Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws.			**CO1**
UNIT- II	**Map Reduce and Software Stack**	**Periods:9**	
. Distributed File Systems, Map Reduce, Algorithms Using Map Reduce, Extensions to Map Reduce, Complexity Theory for Map Reduce.			**CO2**
UNIT- III	**Mining Data Streams**	**Periods:9**	
The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, CountingOnes in a Window, Decaying Windows.			**CO3**
UNIT- IV	**Frequent Item Sets**	**Periods:9**	
The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in MainMemory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.			**CO4**
UNIT- V	**Clustering**	**Periods:9**	
Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism. Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition			**CO5**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Standford Press,2011.
2. Nick Pentreath, "Machine Learning with Spark", Packt Publishing,2015
3. Olivier Chapelle, Bernhard Scholkopf, Alexander Zien "Semi-Supervised Learning", TheMITPress, 2006.

Reference Books

1. Ron Bekkerman, Mikhail Bilenko, John Langford "Scaling Up Machine Learning: Parallel And Distributed Approaches",Cambridge University Press, 2012.
2. Jimmy Lin, Chris Dyer, "Data-Intensive Text Processing with MapReduce", Morgan ClaypoolPublishers, 2010.
3. Hennessy, J.L. and Patterson, D.A., 2011. Computer architecture: a quantitative approach. Elsevier.
4. Chandramani Tiwary "Learning Apache Mahout", Packt Publishing, 2015.
5. Fuchen Sun, Kar-Ann Toh, Manuel Grana Romay, KezhiMao,"Extreme LearningMachines 2013: Algorithms andApplications", Springer, 2014.

Web References

1. https://www.youtube.com/watch?v=waaN9069O3I
2. https://www.ibm.com/cloud/learn/nosql-databases
3. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
4. https://www.geeksforgeeks.org/introduction-to-nosql/
5. https://www.javatpoint.com/nosql-databa

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	3	1	1
2	3	3	3	2	-	-	3	1	1
3	3	3	3	2	2	-	3	1	1
4	3	3	3	2	2	-	3	1	1
5	3	3	3	2	2	-	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDT205**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Streaming Data Analytics**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite								

Course Outcomes		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Recognize the characteristics of data streams that make it useful to solve real-world problems.	**K3**
	CO2	Identify and apply appropriate algorithms for analyzing the data streams for variety of problems	**K3**
	CO3	Implement different algorithms for analyzing the data streams	**K3**
	CO4	Identify the metrics and procedures to evaluate a model	**K3**
	CO5	Knowledge for handling and analyzing streaming data.	**K3**

UNIT- I	**Introduction and Data Streams**	**Periods:9**

Characteristics of the data streams, Challenges in mining data streams Requirements and principlesfor realtime processing, Concept drift Incremental learning. **Data Streams** Counting the Number of Distinct Values in a Stream, Bounds of Random Variables, Poisson Processes,Maintaining Simple Statistics from Data Streams, Sliding Windows, Data Synopsis.

UNIT- II	**Clustering from Data Streams**	**Periods:9**

Clustering Examples: Basic Concepts, Partitioning Clustering - The Leader Algorithm, Single Passk-Means, Micro Clustering, Clustering Variables: A Hierarchical Approach

UNIT- III	**Evaluating Streaming Algorithms**	**Periods:9**

Evaluation Issues, Design of Evaluation Experiments, Evaluation Metrics, Error Estimators using a Single Algorithm and a Single Dataset, Comparative Assessment, The 0-1 loss function, Evaluation Methodology in Non-Stationary Environments The Page-Hinkley Algorithm

UNIT- IV	**Frequent Pattern Mining**	**Periods:9**

Mining Frequent Item sets from Data Streams- Landmark Windows, Mining Recent Frequent Item sets, Frequent Item sets at Multiple Time Granularities Sequence Pattern Mining- Reservoir Sampling for Sequential Pattern Mining over datastreams.

UNIT- V	**Complex Event Processing**	**Periods:9**

Introduction to Complex Event Processing, Features of CEP, Need for CEP, CEP Architectural Layers, Scaling CEP,Events, Timing and Causality, Event Patterns, Rules and Constraint, STRAWEPL, Complex Events and Event Hierarchies.

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Joao Gama, "Knowledge Discovery from Data Streams", CRC Press, 2010.
2. David Luckham, "The Power of Events: An Introduction to Complex Event Processing in DistributedEnterprise Systems",Addison Wesley, 2002.
3. Charu C. Aggarwal, "Data Streams: Models And Algorithms", Kluwer Academic Publishers, 2007.

Reference Books

1. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos,"Understanding Big Data:Analytics forEnterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP,2012.
4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams withAdvancedAnalytics", John Wiley& sons, 2012.
5. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.

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1.https://cloud.google.com › learn https://docs.aws.amazon.com › wellarchitected › late
2.https://www.informatica.com/blogs/streaming-analytics-what-it-is-and-how-it-benefits-your-
3. business.html 3.https://www.tibco.com/reference-center/what-is-streaming-analytics
4.https://learn.microsoft.com/en-us/azure/stream-analytics/stream-analytics-use-reference-data

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	-	-	-
2	3	2	3	3	-	1	-	2	-
3	3	1	3	3	-	1	2	2	-
4	1	1	2	3	3	1	-	2	-
5	2	1	2	3	2	3	2	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDT206**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Big Data with SQL**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Big Data	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Work with big data platform and explore the big data analyticstechniques business applications.	K3
	CO2 Design efficient algorithms for mining the data from large volumes.	K3
	CO3 Analyze the HADOOP and Map Reduce technologies associated wbig data analytics.	K3
	CO4 Explore on Big Data applications Using Hive.	K3
	CO5 Understand the fundamentals of various big data analytics techniques.	K2

UNIT- I	**Introduction To Big Data**	**Periods:9**	
Introduction to big data : Introduction to Big Data Platform – Challenges of Conventional Systems -Intelligentdata analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.			**CO1**
UNIT- II	**Hive Concepts**	**Periods:9**	
Frameworks: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere Big Insights and Streams.			**CO2**
UNIT- III	**Hadoop Eco System**	**Periods:9**	
Hadoop: History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats-Map Reduce Features Hadoop environment.			**CO3**
UNIT- IV	**Big SQL and Hbase**	**Periods:9**	
Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction			**CO4**
UNIT- V	**Hadoop Distributed File System**	**Periods:9**	
Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQTables, Querying Data and User Defined Functions. The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization,Avro and File-Based Data structures.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, “Intelligent Data Mining”, Springer,2007.
2. Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, JamesGiles , David Corrigan, “Harness the Power ofBig Data The IBM Big DataPlatform”, Tata McGraw Hill Publications, 2012.
3. Arshdeep Bahga, Vijay Madisetti, “Big Data Science & Analytics: A HandsOn Approach“,VPT, 2016

Reference Books

1. Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)
2. Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oraclepress.
3. Anand Rajaraman and Jef rey David Ulman, “Mining of Massive Datasets”, Cambridge University Press,2012
4. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, JohnWiley & sons, 2012.
5. Bart Baesens “Analytics in a Big Data World: The Essential Guide to Data Science and itsApplications (WILEY Big DataSeries)”, John Wiley & Sons,2014

Web References

1.https://www.mygreatlearning.com/courses/big-data-analytics-dse
2.https://www.classcentral.com/course/big-data-analysis-9506
3.https://intellipaat.com/big-data- hadoop-training/
4.https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training
5.https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	2	3	2
2	2	2	3	3	2	-	3	3	2
3	2	2	3	3	2	-	2	1	1
4	2	2	3	3	2	-	1	1	2
5	2	2	3	3	2	3	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering(Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II/III**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23BDTD01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**No SQL Databases**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Common to M.Tech CSE(BDA) and M.Tech CSE

Prerequisite	Basics of SQL and Databases	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the detailed architecture, Database properties and storage requirements.	**K2**
	CO2 Differentiate and identify right database models for real time applications.	**K3**
	CO3 Outline Key value architecture, characteristics, and Design Schema and implement CRUD operations, distributed data operations.	**K2**
	CO4 Compare data ware housing schemas and implement various column store internals.	**K3**
	CO5 Choose and implement advanced columnar data model functions for the realtime Applications.	**K4**

UNIT- I	**Introduction to NoSQL**	**Periods:9**	
Data base revolutions: First generation, second generation, third generation, Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions, speeding Performance by strategic use of RAM, SSD, and disk, achieving horizontal scalability with Data base sharing, Brewers CAP theorem.			**CO1**
UNIT- II	**NoSQL Data Architecture Patterns**	**Periods:9**	
NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to Data nodes.			**CO2**
UNIT- III	**Key Value Data Stores and Document Oriented Database**	**Periods:9**	
Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Database. Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharing.			**CO3**
UNIT- IV	**Columnar Data Model – I and II**	**Periods:9**	
Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes. Advanced techniques: Vectorized Processing Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations.			**CO4**
UNIT- V	**Data Modeling with Graph**	**Periods:9**	
Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Dan Sullivan Sullivan, “NoSQL for Mere Mortals”, Addison-Wesley, 2015.
2. Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, “An introduction to Information Retrieval”, Cambridge University Press,2008.
3. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, “The Design and Implementation of Modern Column-Oriented Database Systems”, Now Publishers,2013.

Reference Books

1. Elmasri and Navathe , “Fundamentals of Database Systems”, Pearson Education 2013.
2. Sadalage P & Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Wiley Publications,1st Edition, 2019.
3. Perkins, Eric Redmond, Jim Wilson, Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQLMovement, 2nd Edition, Pragmatic Bookshelf, 2018.
4. Andreas Meier, Michael Kaufmann, “SQL & Nosql Databases”,Repro Books, 2019
5. Guy Harrison, “Next Generation Database: NoSQL and big data”, Apress, 2015.

Web References

1. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
2. https://www.geeksforgeeks.org/introduction-to-nosql/

3. https://www.javatpoint.com/nosql-databa
4. https://intellipaat.com/nosql-cassandra-hbase-training/
5. https://www.udemy.com/nosql/online-cours

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	3	2
2	3	2	2	2	1	2	2	2	1
3	3	1	1	1	2	1	1	1	2
4	3	1	1	2	2	1	2	1	2
5	3	2	2	2	3	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big DataAnalytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PC**			*End Semester Exam Type: **LE**			
Course Code	**P23BDP202**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Big Data with SQL Laboratory**	**-**	**-**	**4**	**2**	**50**	**50**	**100**
Prerequisite	Basics of Big Data and SQL							

Course Outcomes		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	To Describe the key issues in Big Data Management andexperiment with the Hadoop framework	**K2**
	CO2	To Explain the structure and unstructured data by using NoSQLcommands.	**K3**
	CO3	To Apply scientific computing algorithms for finding similar itemsand clustering	**K2**
	CO4	To Test fundamental enabling techniques and scalablealgorithms for data stream mining	**K3**
	CO5	To Develop problem solving and critical thinking skills infundamental enable techniques like Hadoop & MapReduce.	**K4**

List of Experiments:

1. Installation of Hadoop Framework, it's components and study the HADOOP ecosystem.
2. Write a program to implement word count program using MapReduce
3. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication.
4. Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to executeNoSQL Commands.
5. Implementing DGIM algorithm using any Programming Language/ ImplementBloomFilter using any programming language
6. Implement and Perform Streaming Data Analysis using flume for data capture, PYSpark / HIVE for data analysisof twitter data, chat data, webloganalysis etc.
7. Implement any one Clustering algorithm (K-Means/CURE) using Map-Reduce.
8. Implement Page Rank Algorithm using Map-Reduce.
9. Installation of Single Node Hadoop Cluster on Ubuntu
10. Hadoop Programming: Word Count MapReduce Program Using Eclipse
11. Implementing Matrix Multiplication Using One Map-Reduce Step.
12. Implementing Relational Algorithm on Pig.
13. Implementing database operations on Hive.
14. Implementing Bloom Filter using Map-Reduce
15. Implementing Frequent Item set algorithm using Map-Reduce.
16. Implementing Clustering algorithm using Map-Reduce
17. Implementing Page Rank algorithm using Map-Reduce
18. Mini Project:

    Few topics for Projects:
    a. Twitter data analysis
    b. Fraud Detection
    c. Text Mining
    d. Equity Analysis etc.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 4 5**	**Total Periods: 45**

Reference Books

1. Tom White,"Hadoop: The Definitive Guide", O'Reilley, Third Edition, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Vignesh Prajapati ,"Big data analytics with R and Hadoop" , SPD 2013.
4. E. Capriolo, D. Wampler, and J. Rutherglen ,"Programming Hive", O'Reilley, 2012.

Web References

1. https://www.youtube.com/watch?v=waaN9069O3I
2. https://www.ibm.com/cloud/learn/nosql-databases

3. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
4. https://www.geeksforgeeks.org/introduction-to-nosql/
5. https://www.javatpoint.com/nosql-databa

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	3	2
2	3	2	2	2	1	2	2	2	1
3	3	1	1	1	2	1	1	1	2
4	3	1	1	2	2	1	2	1	2
5	3	2	2	2	3	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **HS**			*End Semester Exam Type: **LE**			
Course Code	**P23HSPC02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Seminar on ICT: A Hands-On Approach**	**-**	**-**	**4**	**2**	**100**	**-**	**100**

(Common to all M.Tech Programmes)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Select a topic, narrowing the topic into presentation.	**K2**
	CO2 State an objective and use the relevant ICT tools to make the presentation effective.	**K3**
	CO3 Study the topic and understanding the contributions and prepare report.	**K2**
	CO4 Prepare a working demo.	**K3**
	CO5 Prepare conclusions based on the reading of the topic and giving final Presentation.	**K4**

List of Experiments:

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

ICT skills

- Understand ICT workflow in the respective domain choosed.
- Manage multitasking.
- Deal with main issues using tech in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Scope

- Perspective in order to design activities in class.
- Understand the process of creating audiovisuals.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study on the assigned topic and prepare a report, running to 30 or 40 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 100 marks.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 4 5**	**Total Periods: 45**

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	-	3	1	1	3	3	3	2	1
2	-	3	1	1	3	2	3	2	1
3	-	3	1	1	3	2	3	2	1
4	-	3	1	1	3	2	3	2	1
5	-	3	1	1	3	2	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Attendance		
	Presentation using ICT	Report	viva			
Marks	50	30	10	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **AEC**			*End Semester Exam Type: **-**			
Course Code	**P23CSC2XX**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Ability Enhancement Courses**	**-**	**-**	**4**	**-**	**100**	**-**	**100**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE101**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Data Driven Decision Making**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Big Data	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe multicore architectures and identify their characteristics and Challenges.	**K3**
	CO2 Identify the issues in programming Parallel Processors.	**K3**
	CO3 Make use of OpenMP and MPI.	**K2**
	CO4 Design parallel programming solutions to common problems.	**K3**
	CO5 Compare and contrast programming for serial processors and programming for parallel.	**K3**

UNIT – I	**Introduction to Data-Driven Decision Making**	**Periods:9**
Understanding the role of data in decision making – Importance of data – driven decision making invarious domains – Types of data and data sources – Data collection methods and techniques		**CO1**
UNIT – II	**Data Preprocessing and Exploratory Data Analysis**	**Periods:9**
Data cleaning and data quality assessment – Handling missing data and outliers – Data transformation and normalization techniques – Exploratory Data Analysis (EDA) for understanding data distributions and patterns		**CO2**
UNIT – III	**Statistical Concepts for Decision Making**	**Periods:9**
Probability theory and distributions – Statistical inference and hypothesis testing – Correlation and regression analysis – Understanding p-values and confidence intervals		**CO3**
UNIT – IV	**Machine Learning for Decision Making**	**Periods:9**
Introduction to machine learning algorithms – Supervised, unsupervised, and reinforcement learning – Model training, evaluation, and validation – Feature selection and engineering for better decision-making models		**CO4**
UNIT – V	**Data Visualization and Communication of Results**	**Periods:9**
Principles of Data Visualization– Data visualization techniques and tools – Design principles for effective data visualizations – Storytelling with data: Presenting results to stakeholders – Ethical considerations in data- driven decision making		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. "Data Science for Business" by Foster Provost and Tom Fawcett
2. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross
3. "Python for Data Analysis" by Wes McKinney
4. "Statistical Inference" by George Casella and Roger L. Berger
5. "Data Points: Visualization That Means Something" by Nathan Yau

Reference Books

1. "Data Science from Scratch: First Principles with Python" by Joel Grus
2. "Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer-Schönberger andKennethCukier
3. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
4. "Data-Driven: Creating a Data Culture" by Hilary Mason and DJ Patil
5. "Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

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1. https://www.oreilly.com/library/view/data-science-for/9781449374280/
2. https://www.wiley.com/en-us/The+Data+Warehouse+Toolkit%3A+The+Definitive+Guide+to+Dimensional+Modeling%2C+4th+Edition-p-9781119425822
3. https://www.oreilly.com/library/view/python-for-data/9781491957653/
4. https://www.cengage.com/c/statistical-inference-2e-casella/9780534243128/
5. https://www.wiley.com/en-us/Data+Points%3A+Visualization+That+Means+Something-p-9781118462195

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	2	3	3	3	2
2	3	2	2	2	1	2	2	2	1
3	3	1	1	1	2	1	1	1	2
4	3	1	1	2	2	1	2	1	2
5	3	2	2	2	3	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDEC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Neural Networks**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE(BDA) and CSE)

Prerequisite	Basic Physics	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe the basics of ANN and comparison with Human brain.	**K3**
	CO2 Understand the role of neural networks in engineering, artificia intelligence, and cognitive modelling.	**K2**
	CO3 Understand the concepts and techniques of neural networks throughthe study of the most important neural network models.	**K3**
	CO4 Evaluate whether neural networks are appropriate to a particular application.	**K2**
	CO5 Apply neural networks to particular application, and to know whatsteps to take to improve performance.	**K2**

UNIT- I	**Introduction**	**Periods: 9**
A Neural Network-Human Brain- Models of a Neuron-Neural Networks viewed as Directed Graphs-Network Architectures-Knowledge Representation-Artificial Intelligence and Neural Networks. Learning Process: Error Correction Learning- Memory Based Learning-Hebbian Learning, Competitive- Boltzmann Learning-Credit Assignment Problem- Memory- Adaption- Statistical Natureof the Learning Process.		**CO1**
UNIT- II	**Single Layer Perceptrons**	**Periods: 9**
Adaptive Filtering Problem- Unconstrained Organization Techniques- Linear Least Square Filters- Least Mean Square Algorithm- Learning Curves- Learning Rate Annealing Techniques- Perceptron –Convergence Theorem- Relation Between Perceptron and Bayes Classifier for a Gaussian Environment. Multilayer Perceptron: Back Propagation Algorithm XOR Problem- Heuristics- Output Representation and Decision Rule-Computer Experiment- Feature Detection		**CO2**
UNIT- III	**Back Propagation**	**Periods: 9**
Back Propagation and Differentiation- Hessian Matrix- Generalization- Cross Validation- NetworkPruning Techniques-Virtues and Limitations of Back Propagation Learning- Accelerated Convergence-Supervised Learning.		**CO3**
UNIT- IV	**Self-Organization Maps (SOM)**	**Periods: 9**
Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of FeatureMap, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification.		**CO4**
UNIT- V	**NEURO DYNAMICS**	**Periods: 9**
Dynamical Systems-Stability of Equilibrium States, Attractors-Neuro Dynamical Models - Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models- restricted boltzmen machine.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Ed.
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.
3. Neural Networks A Classroom Approach -Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition.

Reference Books

1. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
2. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
3. Artificial Neural Networks – B. Vegnanarayana Prentice Hall of India P Ltd 2005
4. Introduction to Artificial Neural Systems - J.M. Zurada, Jaico Publications 1994.
5. Artificial Neural Networks- B. Yegnanarayana, Pill, New Delhi 1998.

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1. https://www.cs.rit.edu/~lr/courses/nn/main.html
2. https://www.inspirenignite.com/up/neural-network
3. https://www.investopedia.com/terms/n/neuralnetwork.asp
4. https://www.mygreatlearning.com/blog/types-of-neural-networks/
5. https://link.springer.com/10.1007/978-3-642-20617-7_6563

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	2	1			-	1	3
2	3	3	2	1			-	1	3
3	3	3	2	1			-	1	3
4	3	3	2	1			-	1	3
5	3	3	2	1			-	1	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (BigData Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE102**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Multicore Architectures**	**3**	**1**	**-**	**4**	**40**	**60**	**100**

Prerequisite	MULTICORE ARCHITECTURE	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe multicore architectures and identify their characteristics andchallenges.	**K3**
	CO2 Identify the issues in programming Parallel Processors.	**K3**
	CO3 Make use of OpenMP and MPI.	**K2**
	CO4 Design parallel programming solutions to common problems.	**K3**
	CO5 Compare and contrast programming for serial processors and programmingforparallel.	**K3**

UNIT – I	**Multi-Core Processors**	**Periods:9**
Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.		**CO1**
UNIT – II	**Parallel Program Challenges**	**Periods:9**
Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks,semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).		**CO2**
UNIT – III	**Shared Memory Programming with OpenMP**	**Periods:9**
OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions –Handling Data and Functional Parallelism – Handling Loops – Performance Considerations		**CO3**
UNIT – IV	**Distributed Memory Programming with MPI**	**Periods:9**
MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPIderived datatypes – Performance evaluation		**CO4**
UNIT – V	**Parallel Program Development**	**Periods:9**
Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and Comparison.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. "Computer Architecture: A Quantitative Approach" by John L. Hennessy and David A. Patterson.
2. "Parallel Computer Architecture: A Hardware/Software Approach" by David Culler, Jaswinder Pal Singh, andAnoop Gupta
3. "Multicore Application Programming: For Windows, Linux, and Oracle Solaris" by Darryl Gove.
4. "Programming Massively Parallel Processors: A Hands-on Approach" by David B. Kirk and Wen-mei W. Hwu.
5. "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers"by Barry

Reference Books

1. Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier,2021
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011 (unit 2)
3. Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
4. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

Web References

1. https://software.intel.com/content/www/us/en/develop/topics/multi-core.html
2. https://www.arm.com/resources/education/textbooks/computer-organization-and-design
3. https://developer.nvidia.com/cuda-zone
4. https://developer.amd.com/resources/
5. https://hpc.llnl.gov/training/tutorials

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	2	3	2
2	2	2	3	3	2	-	3	3	2
3	2	2	3	3	2	-	2	1	1
4	2	2	3	3	2	-	1	1	2
5	2	2	3	3	2	3	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSTD01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Advanced Data Structures and Algorithms**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	Basics of Data Structures and Algorithms	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Demonstrate various algorithm notations and algorithm correctness.	**K2**
	CO2 Construct various applications based on sorting and tree data structure.	**K2**
	CO3 Experiment with the performance of various Text Processing operations.	**K3**
	CO4 Apply graph data structures to the real time applications	**K3**
	CO5 Illustrate the performance of the polynomial time algorithm.	**K2**

UNIT- I	**Algorithm Notations and Representations**	**Periods: 9**	
Mathematical Induction - Asymptotic Notations – Algorithm Analysis - NP-Hard and NP-Completeness – Recurrence Equations – Solving Recurrence Equations – Memory Representation of Multi-dimensional Arrays – Time-Space Tradeoffs.			**CO1**
UNIT- II	**Sorting and Trees**	**Periods: 9**	
Heapsort – Quicksort – Topological sort - Sorting in Linear Time – Elementary Data Structures – Hash Tables – Hash Functions- Binary Search Trees – AVL Trees – Red Black trees – Multi-way Search Trees –B-Trees- Fibonacci Heaps – van Emde Boas Trees – Data Structures for Disjoint Sets.			**CO2**
UNIT- III	**Text Processing Operations**	**Periods: 9**	
Text Processing: String Operations - Brute-Force Pattern Matching - The Boyer-Moore Algorithm - The Knuth-Morris-Pratt Algorithm - Standard Tries - Compressed Tries - Suffix Tries - The Huffman Coding Algorithm - The Longest Common Subsequence Problem (LCS) - Applying Dynamic Programming to the LCS Problem.			**CO3**
UNIT- IV	**Graph Algorithms**	**Periods: 9**	
Elementary graph Algorithms – Minimum Spanning Trees – Single Source Shortest Paths- All Pairs Shortest Paths – Maximum Flow - Multithreaded Algorithms – Matrix Operations.			**CO4**
UNIT- V	**Linear Programming**	**Periods: 9**	
Linear programming – Polynomials and Fast Fourier Transform – Number Theoretic Algorithms – Computational Geometry –NP-Completeness – Approximation Algorithms.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, PHI, ThirdEdition, 2016
2.Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, Second Edition, 2004.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Computational Geometry: Algorithms and Application Springer, Third edition, 2008.

Reference Books

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, “Data Structures and Algorithms”, Addison Wesley, Fifth Edition, 201
2. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley , Publishing Company, Sixth Edition, 2016.
3. Narasimha karumanchi, Data Structures and algorithms made easy, Fifth Edition, 2017
4. E. Horowitz, S.Sahni and Dinesh Mehta, “Fundamentals of Data structures in C++”, University Press, Fourth Edition, 2005. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, Second Edition, 2002

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1. https://www.javatpoint.com/data-structure-tutorial/
2. https://www.studytonight.com/data-structures/
3. https://www.tutorialspoint.com/data_structures_algorithms/
4. https://www.w3schools.in/data-structures-tutorial/intro/
5. https://www.geeksforgeeks.org/data-structures

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	1	3	3	3	3	3	3	3
2	2	2	2	2	-	2	2	2	-
3	3	3	3	3	3	3	3	3	3
4	2	2	2	2	-	2	2	2	-
5	2	2	2	2	-	2	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE103**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MACHINE LEARNING**	**3**	**1**	**-**	**4**	**25**	**75**	**100**

Prerequisite	Basics of Artificial Intelligence	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand and outline problems for each type of machine learning	K3
	CO2 Design a Decision tree and Random forest for an application	K3
	CO3 Implement Probabilistic Discriminative and Generative algorithms for an application andanalyze the results	K2
	CO4 Use a tool to implement typical Clustering algorithms for different types of applications.	K3
	CO5 Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	K3

UNIT – I	**Introduction and Mathematical Foundations**	**Periods:9**
What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages &Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics-Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory		**CO1**
UNIT – II	**Supervised Learning**	**Periods:9**
Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods – RandomForest - Evaluation of Classification Algorithms		**CO2**
UNIT – III	**Unsupervised Learning and Reinforcement Learning**	**Periods:9**
Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction – Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning –Temporal Difference Learning		**CO3**
UNIT – IV	**Probabilistic Methods for Learning**	**Periods:9**
Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks - Probabilistic Modellingof Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models		**CO4**
UNIT – V	**Neural Networks and Deep Learning**	**Periods:9**
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network –Back Propagation- Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, First Edition, 2013
2. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014

Reference Books

1. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: FromTheory to Algorithms”, Cambridge University Press, 2015
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
3. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)5
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer, 2009 (freely available online)

5. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

Web References

1. https://nptel.ac.in/courses/106105077
2. https://scikit-learn.org/stable/documentation.html
3. https://www.tensorflow.org/learn
4. https://pytorch.org/docs/stable/index.html
5. http://cs229.stanford.edu/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	2	1	2	2	3	3	1	3
2	1	2	1	2	2	3	3	3	2
3	1	2	1	2	2	3	2	1	3
4	2	2	2	3	2	3	1	1	2
5	3	1	2	3	2	3	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Information Visualization**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Analyze the different data types, visualization types to bring out the insight.	**K3**
	CO2 Make use of Visualization Techniques	**K3**
	CO3 Illustrate different Visual Analytics	**K2**
	CO4 Make use of Data Visualization Tools	**K3**
	CO5 Demonstrate Visualization dashboard creations	**K2**

UNIT-I	**Introduction**	**Periods: 9**	
Overview of data visualization - Data Abstraction - Task Abstraction - Dimensions and Measures - Analysis:Four Levels for Validation. Statistical charts (Bar Chart - stacked bar chart – Line Chart - Histogram - Pie chart- Frequency Polygon - Box plot - Scatter plot - Regression curves			**CO1**
UNIT-II	**Visualization Techniques**	**Periods: 9**	
Introduction to various data visualization tools - Scalar and point techniques - vector visualization techniques -multidimensional techniques - visualizing cluster analysis – K-means and Hierarchical Cluster techniques.			**CO2**
UNIT-III	**Data Visualization and Visual Analytics**	**Periods: 9**	
Time Series data visualization – Text data visualization – Spatial Data Visualization - Networks and Trees - Heat Map – Tree Map - Map Color and Other Channels Manipulate View – Visual Attributes - Multivariate data visualization – Geometric projection techniques - Icon-based techniques - Pixel-oriented techniques - Hierarchical techniques - Scatterplot matrix - Hyper box - Trellis display - Parallel coordinates			**CO3**
UNIT-IV	**Data Visualization Tools**	**Periods: 9**	
Tableau functions and logics: Marks and Channels-Arrange Tables- Arrange Spatial Data- Facets into multiple views			**CO4**
UNIT-V	**Visualization Dashboard Creations**	**Periods: 9**	
Data Dashboard- Taxonomies- User Interaction- Organizational Functions-Dashboard Design – Worksheets - Workbooks – Workbook Optimization - Protection and common mistakes. Dashboard creation using visualization tool use cases: Finance-marketing-insurance-healthcare			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Tamara Munzer, Visualization Analysis and Design, 1st edition, CRC Press, United States, 2015.
2.Michael Fry, Jeffrey Ohlmann, Jeffrey Camm, James Cochran, Data Visualization: Exploring and Explaining with Data, South-Western College Publishing, 2021

Reference Books

1. Ben Fry, Visualizing Data, 1st edition, O'Reilly Media, United States, 2008.
2. Avril Coghlan, A little book of R for multivariate analysis, 1st edition, Welcome Trust Sanger Institute,United Kingdom, 2013.
3.Colin Ware,Information Visualization Perception for Design,2 nd Edition ,Elsevier Science,2019
4. Riccardo Mazza,Introduction to Information Visualization,1st EditionSpringer London,2009
5.Claus O. Wilke,undamentals of Data Visualization,O'Reilly MediaInc,2019

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1. https://www.tableau.com/
2. https://www.sciencedirect.com/science/article/pii/S2452414X19300573
3. https://study.com/academy/lesson/information-visualization-tools-techniques.html
4. https://www.youtube.com/watch?v=_YfHDbADy4s
5. https://www.nobledesktop.com/learn/data-visualization/video-tutorials

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	2	1	2	2	3	3	1	3
2	1	2	1	2	2	3	3	3	2
3	1	2	1	2	2	3	2	1	3
4	2	2	2	3	2	3	1	1	2
5	3	1	2	3	2	3	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	II	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC03**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Text, Web and Social Media Analytics**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand Text Mining	**K2**
	CO2 Illustrate Web Mining	**K3**
	CO3 Make use of Social Network Analysis	**K2**
	CO4 Exploit Social Media Mining	**K3**
	CO5 Make use of Sentimental Mining	**K3**

UNIT- I	**Introduction to Text Mining**	**Periods: 9**	
Text Representation- tokenization, stemming, stop words, TF-IDF, Feature Vector Representation, NER, N-gram modeling. Text Clustering, Text Classification, Topic Modeling-LDA,HDP			**CO1**
UNIT- II	**Introduction to Web-Mining**	**Periods: 9**	
Inverted indices and Boolean queries. PLSI, Query optimization, page ranking. Web Crawling-Crawler Algorithms, Implementation Issues, Evaluation, Session & visitor Analysis, Visitor Segmentation, Analysis of Sequential & Navigational Patterns, Predictions based on web user transactions.			**CO2**
UNIT- III	**Fundamentals of Social Network Analysis**	**Periods: 9**	
Social Network Perspective, Fundamentals concepts in Network Analysis: Sociogram, Sociometry. Social Network Data: Types of Networks: One-Mode, Two-Mode, Affiliation, Ego-centered and Special Dyadic Networks, NetworkData, Measurement and Collection, Notations for Social Network Data: Graphs, Directed, Singed, Valued graphs, Multigraph, Relations and Matrices			**CO3**
UNIT- IV	**Social Media Mining**	**Periods: 9**	
Introduction to Social Media Network Essentials of Social graphs, Social Networks, Models, Information Diffusionin Social Media. Behavioral Analytics, Influence and Homophily, Recommendation in Social Media			**CO4**
UNIT- V	**Sentimental Mining**	**Periods: 9**	
Sentiment classification feature based opinion mining, comparative sentence and relational mining, Opinion spam			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Bing Liu, “Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data”, Springer, Second Edition, 2011.
2. Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, “Social Media Mining – An Introduction”, Cambridge UniversityPress, 2014.
3. Bing Liu, “Sentiment Analysis and Opinion Mining”, Morgan & Claypool Publishers, 2012.

Reference Books

1. Nitin Indurkhya, Fred J Damerau, “Handbook of Natural Language Process”, 2nd Edition, CRC Press, 2010.
2. Matthew A.Russell, “Mining the social web”, 2nd edition- O'Reilly Media, 2013.
3. Gabor Szabo, Gungor Polatkan, P. Oscar Boykin, Antonios Chalkiopoulos,”Social Media Data Mining and Analytics”, Willey, 2018
4. Ganis,Kohirkar,” Social Media Analytics”, Pearson Education India, 2016
5. Marshall Sponder,” Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics”, McGraw-Hill Education,2014

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1.https://machinelearninggeek.com/text-analytics-for-beginners-using-python-nltk/
2.https://towardsdatascience.com/a-guide-text-analysis-text-analytics-text-mining-f62df7b78747
3.https://www.tutorialspoint.com/web_analytics/index.html
4.https://www.tutorialspoint.com/social_media_marketing/social_media_analysis.htm
5.https://www.simplilearn.com/web-analytics-guide-for-newbies-article

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	2	1	2	2	3	3	1	3
2	1	2	1	2	2	3	3	3	2
3	1	2	1	2	2	3	2	1	3
4	2	2	2	3	2	3	1	1	2
5	3	1	2	3	2	3	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I/ II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSTD02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Speech and Language Processing**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	Natural language processing, Machine Learning	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basics of NLP	**K3**
	CO2 Apply the basic ML and DL techniques for NLP	**K3**
	CO3 Understand and realize the advanced NLP Techniques.	**K2**
	CO4 Understand the concept of NLU, NLG and apply the concept of Information Retrieval	**K3**
	CO5 Apply ethics to be followed while building NLP Applications and how to use NLP Libraries	**K3**

UNIT – I	**Introduction**	**Periods:9**
Phases of NLP, Text Preprocessing: Tokenization, Stemming and Lemmatization, Pos Tagging, Named Entity Recognition. NLP Feature Engineering, Word Count Vector, Word Sense Disambiguation		**CO1**
UNIT – II	**Language Modelling**	**Periods:9**
N -gram Models, Hidden Markov Models, Maximum Likelihood Estimation. Supervised, Unsupervised and Semi Supervised Learning.TextClassification and Sentiment Analysis, Topic Modelling and Clustering, Word Embeddings, RNN & LSTMs for NLP, CNN for NLP.		**CO2**
UNIT – III	**Advanced NLP Techniques**	**Periods:9**
Sequence- to -Sequence Models, Attention Mechanisms, Transformer Architecture: BERT, GPT		**CO3**
UNIT – IV	**Language Understanding and Generation, Information Retrieval**	**Periods:9**
Text Generation, Question Answering, Dialogue Systems and Chatbots. Machine Translation, Cross Lingual Transfer Learning. TextIndexing and Search, Text Summarization.		**CO4**
UNIT – V	**NLP Tools, Libraries, Applications, Ethics**	**Periods:9**
Bias and Fairness in NLP, Privacy Concerns in NLP Applications. NP libraries: NLTK, Spacy, Tensor Flow, Pytorch. NLP Applications: Sentiment Analysis, Named Entity Recognition in Real World Data Sets, Text Classification for Various Domains.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Christopher D. Manning and Hinrich Schutze, " Foundations of Natural Language Processing" ,13th Edition, The MIT Press Cambridge, Massachusetts London, England, 2018
2.Daniel Jurafsky and James H. Martin "Speech and Language Processing", 16th edition, Prentice Hall, 2021.
3.Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application".PACKT publisher, 2018

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1.NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
2.James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
3.Chris Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MITPress Cambridge, MA, 2003.
4.Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.
5.Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012.

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1. https://www.udemy.com/course/chatbot/
2. https://gtuematerial.in/natural-language-processing-3170723/
3. https://chatbotsmagazine.com/understanding-the-need-for-nlp-in-your-chatbot-78ef2651de84?gi=ecca664b642a

4. https://www.ultimate.ai/blog/ai-automation/how-nlp-text-based-chatbots-work
5. https://www.javatpoint.com/nlp

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	2	1	2	2	3	3	1	3
2	1	2	1	2	2	3	3	3	2
3	1	2	1	2	2	3	2	1	3
4	2	2	2	3	2	3	1	1	2
5	3	1	2	3	2	3	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	II	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDEC02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Web Analytics and Development**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE(BDA) and AI&DS)

Prerequisite	Internet Programming	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the Web analytics platform, and their evolution.	**K3**
	CO2 Use the various Data Streams Data.	**K3**
	CO3 Know how the survey of capturing of data will benefit.	**K2**
	CO4 Understand Common metrics of web as well as KPI related concepts.	**K3**
	CO5 Apply various Web analytics versions in existence.	**K3**

UNIT – I	**Introduction**	**Periods:9**	
Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analyticsevolution, Need for web analytics, Advantages, Limitations			**CO1**
UNIT – II	**Data Collection**	**Periods:9**	
Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: Ecommerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.			**CO2**
UNIT – III	**Qualitative Analysis**	**Periods:9**	
Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, post-visit surveys, creating andrunning a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, selecting optimal web analytic tool, Understanding click stream data quality, identifying unique page definition, Using cookies, Link coding issues.			**CO3**
UNIT – IV	**Web Metrics**	**Periods:9**	
Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, new visits; Optimization (e-commerce, non-e- commerce sites): Improving bounce rates, Optimizing AdWords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics,Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.			**CO4**
UNIT – V	**Web Analytics 2.0**	**Periods:9**	
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sourcesToolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends Analyzing competitive site overlap and opportunities. Google Analytics: Brie introduction and working, AdWords, BenchmarkingCategories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012.

2.Jure Leskovec, Anand Rajaraman, and Jeffrey D. Ullman , "Mining of Massive Datasets" 2nd edition, Cambridge University Press, 2014

3.Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, WileyPublishing, Inc. 1st ed, 2010

References Books

1. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons,2002

2. Brian Clifton , "Advanced Web Metrics with Google Analytics" , Sybex, Third Edition, 2012

3. Jerri L. Ledford and Joe Teixeira , "Learning Web Analytics: A Beginner's Guide to Google Analytics", O'Reilly Media, 2010

Pedro Sostre ,"Web Analytics For Dummies" , For Dummies, Second Edition , 2012

4. Avinash Kaushik ,"Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity" , Sybex, 2nd Edition, 2009

Web References

1. https://www.mygreatlearning.com/courses/big-data-analytics-dse
2. https://intellipaat.com/big-data-hadoop-training/

3. https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	2	1			-	1	3
2	3	3	2	1			-	1	3
3	3	3	2	1			-	1	3
4	3	3	2	1			-	1	3
5	3	3	2	1			-	1	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	II	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE204**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Expert System and Decision Making**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Artificial Intelligence, Knowledge Representation	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Familiar with basic concepts of Expert System	**K3**
	CO2 Understanding the concepts of Expert System design	**K3**
	CO3 Key management concepts and their decision-making processes for the organization	**K2**
	CO4 Ability to develop corporate strategy, organizational development and change programs and ensure their implementation	**K3**
	CO5 Decision-making methods and technologies variety and their applications	**K3**

UNIT – I	**Introduction to Expert Systems**	**Periods: 9**	
Introduction to Expert Systems-Basic activates of expect system-Interoperation, Prediction and diagnosis – Design, Planning and Monitor-Debugging Repair, instruction and control-Basic expects of Experts systems- Acquisition Modules frames of expert system, Knowledge base- Production rule, Sematic net and inference engine, Backward chaining and forward chaining.			**CO1**
UNIT – II	**Expert Systems Design and Development**	**Periods: 9**	
Sources of uncertainty in rules, methods of dealing with uncertainty, Dempster-Shafer theory, theory of uncertainty based on fuzzy logic, commercial applications of fuzzy logic. How to select an appropriate problem, the stages in the development of an expert system, types of errors to expect in the development stages, the role of the knowledge engineer in the building of expert systems, the expected life cycle of an expert system, how to do a life cycle model.			**CO2**
UNIT – III	**Problem Solving And Decision Making.**	**Periods: 9**	
Definition of the problem and potential causes for the problem-Identifying alternatives for approaches to resolve the problem. - Selecting an approach to resolve the problem. – Implementation of the best alternative. -Action plan.- Monitoring implementation of the plan. - Rational Versus Organic Approach to Problem Solving. -Discover Your Decision Making Style.			**CO3**
UNIT – IV	**Decision Making Process**	**Periods: 9**	
Disciplined decision-making process. -Formal decision making method. -Time decisions. - Problem definition. -Requirements identification. -Goal establishment. -Evaluation criteria development. - General Decision–Making Process (scheme). -Paired Comparison Analysis.			**CO4**
UNIT – V	**Decision Making Methods**	**Periods: 9**	
Decision Analysis techniques. -Pros and Cons Analysis. -Pros and Cons Analysis(example). - Kepner-Tregoe (K-T) Decision Analysis. -Kepner-Tregoe (K-T) Decision Analysis (example),K- TTroubleshooting Methodology. - Determining pros and cons of franchising by using SWOT- analysis.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Bratko, I., Prolog Programming for Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th edition, 2011.
2.Stuart Russel, Peter Norvig “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education 2009.
3. Rajasekaran. S.. Vijayalakshmi Pai. G.A. “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice Hall of India Private Limited, 2003

Reference Books

1. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning series), The MIT Press; second edition, 2009.
2. Nils J. Nilsson, the Quest for Artificial Intelligence, Cambridge University Press, 2009.
3. Elaine Rich, Kevin Knight, “Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.

4. M. Tim Jones, Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc; 1 edition, 2008
5. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill, 2008

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1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.reddit.com/r/artificial/
3. https://www.geeksforgeeks.org/artificial-intelligence-an-introduction/
4. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm
5. https://www.javatpoint.com/expert-systems-in-artificial-intelligence

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE205**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Information Retrieval**	**3**	**-**	**-**	**3**	**0**		**00**

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Build an Information Retrieval system using the available tools.	**K3**
	CO2 Identify and design the various components of an Information Retrievalsystem.	**K3**
	CO3 Categorize the different types of IR Models.	**K2**
	CO4 Apply machine learning techniques to text classification andclustering which is used for Efficient Information Retrieval.	**K3**
	CO5 Design an efficient search engine and analyze the Web contentstructure	

UNIT- I	**Introduction**	**Periods: 9**	
Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine.			**CO1**
UNIT- II	**Modeling**	**Periods: 9**	
Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting — Scoring and Ranking – Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models –Structured Text Retrieval Models – Models for Browsing			**CO2**
UNIT-III	**Indexing**	**Periods: 9**	
Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency			**CO3**
UNIT-IV	**Evaluation and Parallel Information Retrieval**	**Periods: 9**	
Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –QueueingTheory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce			**CO4**
UNIT-V	**Searching the Web**	**Periods: 9**	
Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.

2.Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge,Massachusetts London, England, 2016.

Reference Books

Web Resources

1.Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.

2.Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval

Web References

1. https://www.mygreatlearning.com/courses/big-data-analytics-dse
2. https://intellipaat.com/big-data-hadoop-training/
3. https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**					
Semester	II	Course Category : **PE**			*End Semester Exam Type: **TE**		
Course Code	**P23BDE206**	Periods / Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**Supply Chain Analytics**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Getting the Knowledge of Analytic Hierarchy Process (AHP).	**K2**
	CO2 Illustrate Data Envelopment Analysis (DEA)	**K2**
	CO3 Make use of Fuzzy Logic and Techniques	**K3**
	CO4 Make use of Analytical network process (ANP)	**K3**
	CO5 Analyze MCDM Models	**K3**

UNIT - I	**Introduction**	**Periods:9**	
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supplychains.			**CO1**
UNIT - II	**Warehousing Decisions**	**Periods:9**	
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, SpaceDetermination and Layout Methods.			**CO2**
UNIT - III	**Inventory Management**	**Periods:9**	
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT,Risk Analysis in Supply Chain, Risk pooling strategies.			**CO3**
UNIT - IV	**Transportation Network Models**	**Periods:9**	
Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Setcovering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.			**CO4**
UNIT - V	**MCDM Models**	**Periods:9**	
Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic a Techniques, theanalytical network process (ANP), TOPSIS.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Nada R. Sanders, “Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence”, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, “Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain”, Pearson Education, 2013.
3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, “Networks Against Time: Supply Chain Analytics for Perishable Products”, Springer, 2013.

Reference Books

1.Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, “Analytics in Operations/Supply Chain Management” , I.K. International Publishing House Pvt. Ltd., 2016.
2.Gerhard J. Plenert, “Supply Chain Optimization through Segmentation and Analytics”, CRC Press, Taylor & Francis Group, 2014.
3. T. A. S. Vijayaraghavan, “Supply Chain Analytics”, Wiley, 2021.
4. Peter W Robertson,” Supply Chain Analytics Using Data to Optimise Supply Chain Processes”, Routledge, 2020

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1. https://www.researchgate.net/publication/255621095_Guidebook_to_Decision-Making_Methods
2. https://docplayer.net/415860-Guide-to-cost-benefit-analysis-ofinvestment-projects.html
3. http://www.informs.org/Community/DAS
4. http://www.mindtools.com/pages/article/newTED_01.htm
5. http://managementhelp.org/groups/group-decision-making.htm

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	3	2	2	3	2	2
2	3	2	2	2	2	2	3	2	2
3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**					
Semester	**II**	Course Category : **PE**			*End Semester Exam Type: **TE**		
Course Code	**P23BDE207**	Periods / Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**Cryptography and Information Security**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	**No Prerequisite needed**	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the fundamentals of networks security, security architecture, threats and vulnerabilities	**K2**
	CO2 Apply the different cryptographic operations of symmetric cryptographic algorithms	**K3**
	CO3 Apply the different cryptographic operations of public key cryptography	**K2**
	CO4 Understand various Security practices and System securitystandards	**K2**
	CO5 Understand the fundamentals of networks security, security architecture, threats and vulnerabilities	**K2**

UNIT- I	**Introduction**	**Periods: 9**
Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiplelevels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSIsecurity architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory –product cryptosystem – cryptanalysis.		**CO1**
UNIT- II	**Block Cipher and Data EncryptionStandards**	**Periods: 9**
MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid 's algorithm-Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.		**CO2**
UNIT- III	**Public Key Cryptography**	**Periods: 9**
MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Keydistribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic- Elliptic curve cryptography.		**CO3**
UNIT- IV	**Message Authentication and Integrity**	**Periods: 9**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA – Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics,Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509		**CO4**
UNIT- V	**Security Practice and System Security**	**Periods:9**
Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.William Stallings, "Cryptography and Network Security: Principles and Practice", 4th edition, Pearson Education, India,2006
2.William Stallings," Network Security Essentials (Applications and Standards)", Pearson Education, India.,2000
3.Robert Bragg, Mark Rhodes, "Network Security: The complete reference", Tata Grawhill, India,2004

Reference Books

1.Charlie Kaufman, "Network Security: Private Communication in a Public World", 2nd edition, Prentice Hall of India,2002
2.Atul Kahate, "Cryptography and Network Security", 2nd edition, Tata Mc Grawhill, India.2008
3. Hugo Hoffman, "Cybersecurity, Cryptography And Network Security For Beginners"2020
4. Sunil Gupta," Introduction to Cryptography & Network Security", S.K. Kataria & Sons,2013
5. Savita Gandhi, Bhushan Trivedi ," Cryptography and Network Security", BPB Publications,2021.

Web References

1.https://www.mygreatlearning.com/courses/big-data-analytics-dse
2.https://intellipaat.com/big-data-hadoop-training/

3.https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE208**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Semantic Web and Knowledge Management**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Web	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Demonstrate the semantic web technologies like Semantic Web technologies	**K1**
	CO2 Learn the various semantic web applications	**K3**
	CO3 Identify the architectures and challenges in building social networks	**K4**
	CO4 Use the knowledge management tools.	**K3**
	CO5 Develop knowledge management Applications.	**K3**

UNIT- I	**Introduction to Semantic**	**Periods: 9**
Web Intelligence Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.		**CO1**
UNIT-II	**Semantic Web**	**Periods: 9**
Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema, Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e- Learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services.		**CO2**
UNIT-III	**Introduction to Knowledge Management**	**Periods: 9**
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management-Ethics.		**CO3**
UNIT-IV	**Creating The Culture of Learning and Knowledge**	**Periods: 9**
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.		**CO4**
UNIT-V	**Knowledge Management - The Tools**	**Periods: 9**
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval -Information Coding in the Internet Environment - Repackaging Information.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1 .Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.
2.Social Networks and the Semantic Web, Peter Mika, Springer, 2007.
3.Srikantaiah,T.K., Koenig, M., "Knowledge Management for the Information Professional" .

Reference Books

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group).
3. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor, O'Reilly.

Web References

1. https://www.mygreatlearning.com/courses/big-data-analytics-dse
2. https://intellipaat.com/big-data-hadoop-training/
3. https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	1	-	2	1	1	2	2
2	2	1	1	2	2	1	1	2	2
3	2	2	2	2	1	1	1	2	1
4	2	3	1	-	-	1	1	2	1
5	2	2	3	-	3	1	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE209**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Artificial Intelligence**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Implement any three problem solving methods for a puzzle of your choice	**K1**
	CO2 Understand Game playing and implement a two-player game using AI techniques	**K3**
	CO3 Design and Implement an example using predicate Logic.	**K2**
	CO4 Implement a case-based reasoning system	**K3**
	CO5 Discuss some methodologies to design ethical and explainable AIsystems	**K4**

UNIT- I	**Introduction and Problem Solving**	**Periods: 9**	
Artificial Intelligence -Introduction - Problem-solving -Solving Problems by Searching – Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Local Search - Search in Partially Observable Environments			**CO1**
UNIT- II	**Adversarial Search and Constraint Satisfaction Problems**	**Periods: 9**	
Game Theory- Optimal Decisions in Games - Heuristic Alpha--Beta Tree Search- Monte Carlo Tree Search - Stochastic Games - Partially Observable Games - Limitations of Game Search Algorithms Constraint Satisfaction Problems (CSP)– Examples - Constraint Propagation Backtracking Search for CSPs - Local Search for CSP.			**CO2**
UNIT-III	**Knowledge, Reasoning and Planning**	**Periods: 9**	
First Order Logic – Inference in First Order Logic -Using Predicate Logic - Knowledge Representation - Issues -Ontological Engineering - Categories and Objects – Reasoning Systems for Categories - Planning -Definition - Algorithms -Heuristics for Planning -Hierarchical Planning			**CO3**
UNIT-IV	**Uncertain Knowledge and Reasoning**	**Periods: 9**	
Quantifying Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time 19 Probabilistic Programming –Making Simple Decisions - Making Complex Decisions - Case Based Reasoning – Explanation-Based Learning – Evolutionary Computation			**CO4**
UNIT-V	**Philosophy, Ethics and Safety of AI**	**Periods: 9**	
The Limits of AI – Knowledge in Learning –Statistical Learning Methods – Reinforcement Learning - Introduction to Machine Learning and Deep Learning -Can Machines Really Think? - Distributed AI Artificial Life-The Ethics of AI - Interpretable AI-Future of AI - AI Components -AI Architectures			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, 4th Edition, 2020.
2. Zhongzhi Shi “Advanced Artificial Intelligence”, World Scientific; 2019.
3. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence”, McGraw Hill Education; 3rd edition, 20174. Christopher Manning, “Foundations of Statistical Natural Language Processing”, MIT Press, 2009.

Reference Books

1.Richard E. Neapolitan, Xia Jiang, “Artificial Intelligence with an Introduction to Machine Learning”, Chapman and Hall/CRC; 2nd edition,
2.Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., New Delhi, 2013.
3.Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann Publishers Inc; Second Edition, 2003.
4. Max Tegmark, “Life 3.0: Being Human in the Age of Artificial Intelligence”, Deckle Edge, 2017
5. Nick Bostrom,” Superintelligence: Paths, Dangers, Strategies”, Oxford University Press,2016.

Web References

1. https://www.mygreatlearning.com/courses/big-data-analytics-dse
2. https://intellipaat.com/big-data-hadoop-training/
3. https://www.edureka.co/comprehensive-hive

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**English for Research Paper Writing**	**2**	**-**	**-**	**-**	**100**	**-**	**100**
(Common to all M.Tech Programme)								
Prerequisite	No Prerequisite							

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand that how to improve your writing skills and level of readability.	**K2**
	CO2 Learn about what to write in each section.	**K1**
	CO3 Understand the skills needed when writing a Title.	**K2**
	CO4 Understand the skills needed when writing the Conclusion.	**K2**
	CO5 Ensure the good quality of paper at very first-time submission.	**K3**

UNIT- I	**Introduction to Research Paper Writing**	**Periods: 6**	
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.			**CO1**
UNIT- II	**Presentation Skills**	**Periods: 6**	
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.			**CO2**
UNIT- III	**Title Writing Skills**	**Periods: 6**	
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.			**CO3**
UNIT- IV	**Result Writing Skills**	**Periods: 6**	
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.			**CO4**
UNIT- V	**Verification Skills**	**Periods: 6**	
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Adrian Wallwork, “English for Writing Research Papers”, Springer, New York, Dordrecht Heidelberg London, 2011.
2. Day R, “How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006.
3. Goldbort R, “Writing for Science”, Yale University Press (Available on Google Books), 2006.
4. Highman N, “Handbook of Writing for the Mathematical Sciences”, SIAM. Highman’s book, 1998.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Disaster Management**	**2**	**-**	**-**	**-**	**100**	**-**	**100**
(Common to all M.Tech Programme)								
Prerequisite								

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Ability to summarize basics of disaster.	**K1**
	CO2 Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.	**K2**
	CO3 Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	**K3**
	CO4 Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	**K3**
	CO5 Ability to develop the strengths and weaknesses of disaster management approaches.	**K3**

UNIT- I	**Introduction**	**Periods: 6**	
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.			**CO1**
UNIT- II	**Repercussions of Disasters and Hazards**	**Periods: 6**	
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.			**CO2**
UNIT- III	**Disaster Prone Areas in India**	**Periods: 6**	
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.			**CO3**
UNIT- IV	**Disaster Preparedness and Management**	**Periods: 6**	
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.			**CO4**
UNIT- V	**Risk Assessment**	**Periods: 6**	
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Goel S. L., "Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2007.
3. Sahni, Pardeep Et.Al. , "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2001.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX03**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Sanskrit for Tecnical Knowledge**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understanding basic Sanskrit language.	**K2**
	CO2 Write sentences	**K2**
	CO3 Know the order and roots of Sanskrit.	**K3**
	CO4 Know about technical information about Sanskrit literature	**K3**
	CO5 Understand the technical concepts of Engineering.	**K2**

UNIT- I	**Alphabets**	**Periods: 6**
Alphabets in Sanskrit.		**CO1**
UNIT- II	**Tenses and Sentences**	**Periods: 6**
Past/Present/Future Tense - Simple Sentences.		**CO2**
UNIT- III	**Order and Roots**	**Periods: 6**
Order - Introduction of roots of Engineering-Electrical, Mechanical, Architecture, Mathematics.		**CO3**
UNIT- IV	**Sanskrit Literature**	**Periods: 6**
Technical information about Sanskrit Literature.		**CO4**
UNIT- V	**Technical Concepts of Engineering**	**Periods: 6**
Technical concepts		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Dr. Vishwas, “Abhyaspustakam”, Samskrita-Bharti Publication, New Delhi.
2. Prathama Deeksha, Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, “Teach Yourself Sanskrit”, New Delhi Publication.
3. Suresh Soni, “India’s Glorious Scientific Tradition”, Ocean books (P) Ltd., New Delhi, 2017

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX04**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Value Education**	**2**	**-**	**-**	**-**	**100**	**-**	**100**
(Common to all M.Tech Programme)								
Prerequisite								

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Knowledge of self-development.	**K2**
	CO2 Learn the importance of Human values.	**K1**
	CO3 Developing the overall personality.	**K3**
	CO4 Developing Character and Competence	**K3**

UNIT- I	**Values and Self Development**	**Periods: 6**	
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgments of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.			**CO1**
UNIT- II	**Cultivation of Values**	**Periods: 6**	
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline			CO2
UNIT- III	**Personality Development**	**Periods: 6**	
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.			**CO3**
UNIT- IV	**Character Development**	**Periods: 6**	
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role.			**CO4**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX05**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Constitution of India**	**2**	**-**	**-**	**3**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	**K3**
	CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	**K3**
	CO3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections.	**K3**
	CO4 Discuss the passage of the Hindu Code Bill of 1956.	**K3**
	CO5 Discuss the administration and Election commission	**K3**

UNIT- I	**History of Making of The Indian Constitution**	**Periods: 6**	
History, Drafting Committee, (Composition & Working).			**CO1**
UNIT- II	**Philosophy of The Indian Constitution**	**Periods: 6**	
Preamble, Salient Features.			**CO2**
UNIT- III	**Contours of Constitutional Rights and Duties**	**Periods: 6**	
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.			**CO3**
UNIT- IV	**Organs of Governance**	**Periods: 6**	
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.			**CO4**
UNIT- V	**Local Administration and Election Commission**	**Periods: 6**	
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. "The Constitution of India, 1950(Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1 st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. Suresh Soni, "India's Glorious Scientific Tradition" Ocean books (P) Ltd., New Delhi, 2017.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX06**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Pedagogy Studies**	**2**	**-**	**-**	**3**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?	**K2**
	CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?	**K2**
	CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	**K2**
	CO4	Illustrate Professional development	**K3**
	CO5	Identify Research gaps and Future Directions	**K3**

UNIT- I	**Introduction and Methodology**	**Periods: 6**	
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.			CO1
UNIT- II	**Thematic Overview**	**Periods: 6**	
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.			**CO2**
UNIT- III	**Evidence on The Effectiveness of Pedagogical Practices**	**Periods: 6**	
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies			**CO3**
UNIT- IV	**Professional Development**	**Periods: 6**	
Professional development: alignment with classroom practices and follows up support – Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes			**CO4**
UNIT- V	**Research Gaps and Future Directions**	**Periods: 6**	
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Ackers J, Hardman,F, "Classroom interaction in Kenyan primary schools, Compare", 31(2): 245- 261, 2001.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies", 36(3):361-379, 2004.
3. Akyeampong K, "Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report", London, DFID, 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?", International Journal Educational Development, 33(3): 272–282, 2013.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education", Oxford and Boston: Blackwell, 2001.
6. Chavan M, "Read India: Amass scale, rapid, 'learning to read' campaign", 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Assignment 1	Assignment 2	Test 1	Test 2	Attendance		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX07**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Stress Management by Yoga**	**2**	**-**	**-**	**3**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Develop healthy mind in a healthy body thus improving social health also	**K2**
	CO2 Improve efficiency.	**K2**
	CO3 Understand Asan and Pranayam	**K2**
	CO4 Apply Asanas	**K4**
	CO5 Apply Pranayam	**K4**

UNIT- I	**Introduction**	**Periods: 6**	
Definitions of Eight parts of yoga. (Ashtanga).			**CO1**
UNIT- II	**Do`s and Don't's in Life**	**Periods: 6**	
Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.			**CO2**
UNIT- III	**Asan and Pranayam**	**Periods: 6**	
Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam.			**CO3**
UNIT- IV	**Asan Practices**	**Periods: 6**	
Practice on Various yoga poses			**CO4**
UNIT- V	**Pranayam Practices**	**Periods: 6**	
Practice on various pranayam			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Janardan Swami Yoga bhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I", Nagpur.
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama Publication Department, Kolkata

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX08**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Personality Development through Life Enlightenment Skills**	**2**	**-**	**-**	**3**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.	**K3**
	CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity.	**K1**
	CO3	Study of Neet is hatakam will help in developing versatile personality of students.	**K3**

UNIT- I	**Periods: 6**	
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) 4-Verses 18, 38,39 Chapter18 – Verses37,38,63.		**CO1**
UNIT- II	**Periods: 12**	
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3- Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.model – shrimad bhagwad geeta - Chapter2- Verses 17, Chapter 3-Verses 36,37,42 – Chapter.		**CO2**
UNIT- III	**Periods: 12**	
Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 - Personality of role.		**CO3**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Gopinath, Rashtriya Sanskrit Sansthanam P, "Bhartrihari's Three Satakam, Niti-sringar- vairagya", New Delhi,2010.
2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX09**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Unnat Bharath Abhiyan**	**2**	**-**	**-**	**3**	**100**	**-**	**100**
(Common to all M.Tech Programme)								
Prerequisite								

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Gain an understanding of rural life, culture and social realities	**K3**
	CO2 Develop a sense of empathy and bonds of mutuality with local community	**K1**
	CO3 Appreciate significant contributions of local communities to Indian society and economy	**K3**
	CO4 Learn to value the local knowledge and wisdom of the community	**K3**
	CO5 Identify opportunities for contributing to community's socio-economic improvements.	**K3**

UNIT- I	**Appreciation of Rural Society**	**Periods: 6**	
Rural life style, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages' (Gandhi), rural infrastructure.			**CO1**
UNIT- II	**Understanding Rural Economy and Livelihood**	**Periods: 6**	
Agriculture, farming, landownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets.			**CO2**
UNIT- III	**Rural Institutions**	**Periods: 6**	
Traditional rural organizations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration.			**CO3**
UNIT- IV	**Rural Development Programmes**	**Periods: 6**	
History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralized Planning, NRLM, MNREGA, etc.			**CO4**
UNIT- V	**Field Based Practical Activities**	**Periods: 6**	
Visit MGNREGS project sites. Swachh Bharat project sites, Conduct Mission Antyodaya surveys, Interactive community exercise with local leaders, Panchayat functionaries, Visit Rural Schools / mid-day meal centres, study Academic and infrastructural resources and gaps, Participate in Gram Sabha meetings, Visit local Anganwadi Centre, Conduct soil health test, drinking water analysis.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Singh, Katar, "Rural Development : Principles, Policies and Management", Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, "Sustainable Development Goals", 2015.
4. M.P.Boraian, "Best Practices in Rural Development", Shanlax Publishers, 2016

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE310**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Optimization Techniques for Analytics**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understanding Optimization Techniques	**K2**
	CO2 Illustrate Swarm Intelligence	**K3**
	CO3 Make use of Genetic Algorithm	**K2**
	CO4 Illustrate Swarm Robotics	**K3**
	CO5 Illustrate other swarm intelligent alogrithms	**K3**

UNIT- I	**Introduction**	**Periods: 9**	
Optimization Techniques: Introduction to Optimization Problems – Single and Muti- objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding -representation – fitness function – Reproduction – differences between GA and Traditional optimization methods – Applications – Bio- inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC			**CO1**
UNIT- II	**Swarm Intelligence**	**Periods: 9**	
Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization -Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) -S-ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO – Other Metaheuristics – Simulated annealing – Tabu Search -Local search methods – Scope of ACO algorithms.			**CO2**
UNIT-III	**Genetic Algorithm**	**Periods: 9**	
Introduction-Genetic Algorithm-Components of genetic Algorithm-Encoding-Initialization-Fitness Evaluation-objective function-Selection Stratergies-Crossover Techniques-Mutation and Adaptive Stratergies-Elitism-Parameter -Applications			**CO3**
UNIT-IV	**Swarm Robotics**	**Periods: 9**	
Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics -Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle 164 Swarms for Dynamic Optimization Problems – Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.			**CO4**
UNIT-V	**Case Studies**	**Periods: 9**	
Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University press, 2000.
2. Christian Blum, Daniel Merkle (Eds.), “Swarm Intelligence: Introduction and Applications”, Springer Verlag, 2008.
3. Leandro N De Castro, Fernando J Von Zuben, “Recent Developments in Biologically Inspired Computing”, Idea Group Inc., 2005.

Reference Books

1. Albert S.S.Rao, “Engineering Optimization”, 4th Edition, New Age International, Wiley, 2009
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers
3. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
4. Y.Zomaya, “Handbook of Nature-Inspired and Innovative Computing”, Springer, 2006.
5. C. Ebelhart et al., “Swarm Intelligence”, Morgan Kaufmann, 2001.

Web References

https://helper.ipam.ucla.edu/publications/gss2015/gss2015_12539.pdf
https://www.geeksforgeeks.org/optimization-for-data-science/
https://www.analyticsvidhya.com/blog/2022/10/optimization-essentials-for-machine-learning/

https://nptel.ac.in/courses/111105039
https://archive.nptel.ac.in/courses/108/104/108104112/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II/III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC04**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Data Storage Technologies and Networks**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	**Basics about Storage**	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basic concepts of Storage Technologies. (K2)	**K1**
	CO2 Identify the Storage Items and its Operations. (K2)	**K3**
	CO3 Understand the Networked Storage like DAS, SAN and NAS. (K3)	**K4**
	CO4 Learn the concepts related to Information Availability. (K3)	**K3**
	CO5 Ability to describe Storage Security and Virtualization. (K3)	**K3**

UNIT- I	**Introduction to Storage Technology**	**Periods: 9**	
Data Proliferation and the varying value of data with time and usage - Sources of data and states of data creation - Data center requirements and Evolution to accommodate storage needs - Overview of basic storage management skills and activities - The Five Pillars of Technology - Overview of Storage Infrastructure Components - Evolution of storage - Information Lifecycle Management concept - Data Categorization within an Enterprise - Storage and Regulations.			**CO1**
UNIT- II	**Storage Systems Architecture**	**Periods: 9**	
Intelligent disk subsystems overview - Contrast of integrated vs. modular arrays - Component architecture of intelligent disk subsystems - Disk physical structure components – properties - performance and specifications - Logical partitioning of disks - RAID and parity algorithms - hot sparing - Physical vs. logical disk organization - protection and back end management - Array caching properties and algorithms - Front end connectivity and queuing properties - Front end to host storage provisioning - mapping and operation - Interaction of file systems with storage - Storage system connectivity protocols.			**CO2**
UNIT-III	**Networked Storage**	**Periods: 9**	
JBOD – DAS – SAN - NAS and CAS evolution - Direct Attached Storage (DAS) environments: elements - connectivity and management. Storage Area Networks (SAN): Elements and Connectivity - Fiber Channel principles - Standards and Network management principles - SAN management principles. Network Attached Storage (NAS): elements - connectivity options - connectivity protocols (NFS, CIFS, FTP) and management principles - IP SAN elements - Standards (iSCSI, FCIP, iFCP) - connectivity principles - security and management principles. Content Addressable Storage (CAS): elements, connectivity options – Standards and management principles.			**CO3**
UNIT-IV	**Information Availability**	**Periods: 9**	
Business Continuity and Disaster Recovery Basics - Local business continuity techniques - Remote business continuity techniques - Disaster Recovery principles and techniques Managing and Monitoring Management philosophies (holistic vs. system and component) - Industry management standards (SNMP, SMI-S, CIM) - Standard framework applications - Key Management Metrics (thresholds, availability, capacity, security, performance) - Metric Analysis Methodologies and Trend Analysis - Provisioning and Configuration change planning - Problem reporting - prioritization and handling techniques.			**CO4**
UNIT-V	**Securing Storage and Storage Virtualization**	**Periods: 9**	
Define storage security - List the critical security attributes for information systems - Describe the elements of a shared storage model and security extensions - Define storage security domains - List and analyze the common threats in each domain - Identify different virtualization technologies - Describe block-level and file level virtualization technologies and processes.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Marc Farley Osborne, “Building Storage Networks”, Tata Mcgraw Hill, 2006.
2. EMC, Hopkinton and Massachusetts, “Information Storage and Management Storing, Managing, and Protecting Digital Information”, Wiley, 2008.
3. Robert Spalding, “Storage Networks: The Complete Reference“, Tata Mcgraw Hill, 2002.

Reference Books

1. Gerald J Kowalski, Mark T Maybury, “Information Storage and Retrieval Systems - Theory and Implementation”, BS Publications, 2006.
2. Thejendra BS, “Disaster Recovery & Business Continuity”, Shroff Publishers & Distributors, 2008.

3. Barb Goldworm, Anne Skamarock, “Blade Servers & Virtualization”, Wiley India.
4. Meeta Gupta, “Storage Area Network Fundamentals”, Pearson Education Limited, 2006.
5. John Chirillo, Scott Blaul, “Storage Security Protecting SANs, NAS and DAS”, Wiley, 2003.

Web References

1. https://www.youtube.com/watch?v=bzEaDPu09vY
2. https://www.snia.org/education/storage_networking_primer/san/what_san
3. http://www.ittoday.info/ITPerformanceImprovement/Articles/2013-01Schulz.html
4. https://www.igi-global.com/dictionary/information-availability/14353
5. https://searchstorage.techtarget.com/definition/storage-virtualization

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE311**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Models of Computation**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understanding Regular Languages and Finite Automata	**K1**
	CO2	Make use of Context free grammar (CFG)	**K2**
	CO3	Illustrate Pushdown Automata, CFL And NCFL	**K3**
	CO4	Illustrate Turing Machine	**K3**
	CO5	Make use of Computable Functions and Undecidability	**K2**

UNIT- I	**Regular Languages and Finite Automata**	**Periods: 9**	
Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output - Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, $\wedge$ - Non Deterministic Finite Automata, Conversion of NFA- $\wedge$ to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.			**CO1**
UNIT- II	**Context free grammar (CFG)**	**Periods: 9**	
Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity, Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF			**CO2**
UNIT-III	**Pushdown Automata, CFL And NCFL**	**Periods: 9**	
Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL			**CO3**
UNIT-IV	**Turing Machine**	**Periods: 9**	
TM Definition, Model Of Computation, Turing Machine as Language Acceptor, TM that Compute Partial Function, Church Turning Thesis, Combining TM, Variations Of TM, Non Deterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy			**CO4**
UNIT-V	**Computable Functions and Undecidability**	**Periods: 9**	
Partial - Total - Constant Functions, Primitive Recursive Functions, Bounded Mineralization, Regular function, Recursive Functions, Quantification, Minimalization, and μ-Recursive Functions, All Computable Functions Are μ-Recursive - Undecidability : A Language That Can't Be Accepted, and a Problem That Can't Be Decided , Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Undecidable Problems Involving Context-Free Languages, Post's Correspondence Problem, The Class P and NP			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Hopcroft, _Introduction to Automata Theory, Languages, and Computation‖, Pearson, 3 rd Edition, 2008.
2. Alfred Aho, V. Ravi Sethi, and D. Jeffery Ullman, —Compilers Principles, Techniques and Tools‖, AddisonWesley, 2nd Edition, 2007.
3. John C. Martin, —Introduction to Languages and the Theory of Computations‖, McGraw Hill, 3rd Edition, 2007.

Reference Books

1. Kamala Krithivasan, Rama R, "Introduction to Formal languages Automata Theory and Computation", Pearson, 2019.
2. Peter Linz, "An Introduction to Formal Languages and Automata", Jones & Bartlett, 6th Edition, 2016.
3. Anil Malviya, Malabika Datta, "Theory of Computation & Applications - Automata Theory Formal Languages", BPB publications, 2015.
4. Charles N. Fischer and Richard J. Leblanc, "Crafting a Compiler with C", Benjamin Cummings, 2009.

5. Mishra K.L.P, "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall India Learning, 1 st Edition, 2006.

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2. https://www.cse.iitm.ac.in/~krishna/cs3300/
3. https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/
4. https://www.javatpoint.com/automata-tutorial
5. https://www.tutorialspoint.com/automata_theory/index.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**II/III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Soft Computing**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Apply neural networks, bidirectional associative memories and adaptive resonancetheory for solving different engineering problems	**K2**
	CO2 Identify and describe soft computing techniques and build supervised learning and unsupervised learning networks	**K3**
	CO3 Apply fuzzy logic and reasoning to handle uncertainty and solve various engineeringproblems.	**K2**
	CO4 Apply genetic algorithms to combinatorial optimization problems.	**K2**
	CO5 Evaluate and compare solutions by various soft computing approaches for a given problem	**K3**

UNIT- I	**Introduction to Soft Computing**	**Periods: 9**	
Soft computing vs. hard computing, evolution of soft computing, features and types of softcomputing, applications of soft computing, basics of machine learning.			**CO1**
UNIT- II	**Neural Networks and Back PropagationNetworks**	**Periods: 9**	
Basic concepts of Neural Networks, Model of Artificial Neuron, Neural Network Architectures, Characteristics of neural networks, Learning Methods, Early neural network architectures, Application domains. Back propagation network (BPN), Back propagation Learning, Applications of BPN, Parameter selection, Variations of Back propagation Algorithms			**CO2**
UNIT-III	**Associative Memory Networks**	**Periods: 9**	
Auto correlators, hetero correlators: Kosko's discrete Bi-direction associative memory (BAM), Exponential BAM, Application of Character Recognition			**CO3**
UNIT-IV	**Unsupervised Learning: Adaptive Resonance Theory**	**Periods: 9**	
Adaptive Resonance Theory (ART), Classical ART Networks, Simplifies ART Architecture, Features, algorithms and Illustration of ART1 and ART2 model, Related Applications			**CO4**
UNIT-V	**Fuzzy Sets and Fuzzy Relations**	**Periods: 9**	
Fuzzy versus Crisp, Crisp Sets, Fuzzy sets, Membership functions, fuzzy set operations, properties of Fuzzy sets, Crisp Relations, Fuzzy relations – Fuzzy Cartesian product, Operations of Fuzzy Relations			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. S, Rajasekaran& G.A. VijayalakshmiPai, "Neural Networks, Fuzzy systems and evolutionary algorithms: Synthesis and Applications", PHI Publication, 2nd Ed. 2017
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", John Wiley and Sons, 3rd ed, 2011.
3. S.N. Sivanandam& S.N. Deepa, "Principles of Soft Computing", Wiley Publications, 3rd ed,2018.

Reference Books

1. Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and EijiMizutani. "Neuro-fuzzy and soft computing- a computational approach to learning and machine intelligence" Pearson, 1997.
2. Kosko, B., Neural Networks and Fuzzy Systems: A Dynamical Systems Approach toMachine Intelligence, PHI Publication, 1994.
3. George J. Klir,Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 2015
4. Rich E andKnight K, Artificial Intelligence, McGraw Hill Education; 3rd ed, 2017.
5. Haykin, "Neural Networks and Learning Machines", Pearson Education Inc., 3rd Ed 2008.

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1. https://pdfs.semanticscholar.org/de17/414444750423573b60bfd206d0047a90c0fa.pdf
2. https://link.springer.com/chapter/10.1007/3-540-27335-2_1
3. https://notendur.hi.is/benedikt/Courses/ch01_2005.pdf
4. https://link.springer.com/chapter/10.1007/978-94-011-4405-6_2
5. https://onlinecourses.nptel.ac.in/noc22_cs54/preview

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**		Programme: **M.Tech.**					
Semester	**III**		Course Category : **PE**			*End Semester Exam Type: **TE**		
Course Code	**P23BDE312**		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CAM	ESE	TM
Course Name	**Deep Learning**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	Basics about Machine Learning								
Course Outcomes	**On completion of the course, the students will be able to**						BT Mapping (Highest Level)		
	CO1	Have a good understanding of the fundamental issues and basics of machine learning					**K2**		
	CO2	Ability to differentiate the concept of machine learning with deep learning techniques					**K2**		
	CO3	Understand the concept of CNN and transfer learning techniques, to apply it in the classification problems					**K2**		
	CO4	Learned to use RNN for language modelling and time series prediction.					**K3**		
	CO5	Design and implement various machine learning algorithms in a range of real-world applications.					**K4**		

UNIT- I	**Introduction to Algorithms**	**Periods: 9**
Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and it variants Stochastic gradient decent, Curse of Dimensionality.		**CO1**
UNIT- II	**Introduction to Deep Learning**	**Periods: 9**
Introduction to Deep Learning & Architectures Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders.		**CO2**
UNIT-III	**Convolutional Neural Networks**	**Periods: 9**
Convolutional Neural Networks Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet. - Transfer Learning :Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.		**CO3**
UNIT-IV	**Sequence Modelling**	**Periods: 9**
Sequence Modelling – Recurrent and Recursive Nets ,Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence architechures - BPTT for training RNN, Long Short Term Memory Networks - Auto Encoders Under complete Autoencoders – Regulraized Autoencoders – stochastic Encoders and Decoders – Contractive Encoders.		**CO4**
UNIT-V	**Deep Generative Models**	**Periods: 9**
Deep Generative Models Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine - Generative Adversial Networks.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning", MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media,2017
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

Reference Books

1. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
2. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India,Third Edition 2014.
3. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
4. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.
5. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2. https://www.techtarget.com/searchenterpriseai/definition/deep-learning-deep-neural-network
3. https://www.coursera.org/articles/what-is-deep-learning

4. https://link.springer.com/article/10.1007/s42979-021-00815-1
5. https://www.sciencedirect.com/topics/computer-science/deep-learning

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE313**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Blockchain Technology**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the requirements of the basic design of blockchain	**K2**
	CO2	Identify the need of blockchains to find the solution to the real-world problems	**K2**
	CO3	Recognize the underlying technology of transactions, blocks, proof-of-work, and consensus building	**K3**
	CO4	Design and implement new ways of using blockchain for applications other than cryptocurrency	**K4**
	CO5	Categorize and implement the various platforms	**K2**

UNIT- I	**Introduction**	**Periods: 9**	
Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges - Public Ledgers, Blocks in a Blockchain, Blockchain as public ledgers, Transactions, Distributed consensus. Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory			**CO1**
UNIT- II	**Architecture and Use cases**	**Periods: 9**	
Blockchain Architecture and Use cases Design methodology for Blockchain applications, Blockchain application templates, Blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems			**CO2**
UNIT-III	**Smart Contracts**	**Periods: 9**	
Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mist wallet, smart contract examples, smart contract patterns			**CO3**
UNIT-IV	**Decentralized Applications**	**Periods: 9**	
Decentralized applications (Dapps) - Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps - Byzantine fault tolerance, proof-of-work vs proof-of-stake, Security and Privacy of Blockchain, smart contract vulnerabilities , Scalability of Blockchain			**CO4**
UNIT-V	**Real World Applications**	**Periods: 9**	
Blockchain for real-world applications Manufacturing and production, supply chain management, logistics and transportation, Internet of things, e-voting, healthcare, product life cycle, knowledge and innovation management, new business models and applications			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Bahga A., Madisetti V,"Blockchain applications: a hands-on approach", VPT, 2017.
2. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda "Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions", Apress, 2018.
3. Joseph J.Bambara and Paul R. Allen,Blockchain "A Practical Guide to Developing Business, Law, and Technology Solutions",McGraw Hill, 2018.

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1. Vikram Dhillon, David Metcalf and Max Hooper , "Blockchain enabled Applications", Apress,2017,
2. William Mougayar, Wiley ,"The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology", 2016.
3. Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.
4. Imran Bashir, ―Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more‖, Packt Publishing Limited, 3rd Edition,2020.
5. Dr. T R Padmanabhan C K Shyamala, N Harini , ―Cryptography and Security‖, Wiley,1st Edition,2011.

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1. http://chimera.labs.oreilly.com/books/1234000001802/ch08.html

2. https://bitcoin.org/bitcoin.pdf
3. https://www.geeksforgeeks.org/introduction-to-crypto-terminologies
4. https://complyadvantage.com/knowledgebase/crypto-regulations/cryptocurrency-regulations-india
5. https://www.proofpoint.com/us/threat-reference/encryption

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE314**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Speech Recognition**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Identify the different linguistic components of natural language	**K2**
	CO2	Design a morphological analyzer for a given natural language	**K4**
	CO3	Decide on the appropriate parsing techniques necessary for a given language and application	**K3**
	CO4	Design new tagset and a tagger for a given natural language	**K4**
	CO5	Design applications involving natural language	**K4**

UNIT- I	**Introduction**	**Periods: 9**	
Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.			**CO1**
UNIT- II	**Speech Analysis**	**Periods: 9**	
Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.			**CO2**
UNIT-III	**Speech Modeling**	**Periods: 9**	
Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.Speech Recognition: Large Vocabulary Continuous.			**CO3**
UNIT-IV	**Speech Recognition**	**Periods: 9**	
Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – ngrams, context dependent sub-word units; Applications and present status.			**CO4**
UNIT-V	**Speech Synthesis**	**Periods: 9**	
Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Jurafsky and Martin, “Speech and Language Processing”, Pearson Prentice Hall, Second Edition, 2008.
2. Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003
3. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.

Reference Books

1. Chris Manning, Hinrich Schuetze, —Foundations of Statistical Natural Language Processing‖, MIT Press, 1999.
2. Cole Howard, Hobson Lane, Hannes Hapke, —Natural Language Processing in Action‖ Manning Publication 2019.
3. Li Deng, Yang Liu —Deep Learning in Natural Language Processing‖ Springer, 2018.
4. Tom Hoobyar, Tom Dotz, Susan Sanders, —NLP The Essential Guide to Neuro-Linguistic Programming‖, William Morrow Paperbacks, 2013.
5. Kate Burton, —Coaching With NLP For Dummies‖, Wiley, 2011

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1. https://machinelearningmastery.com/natural-language-processing/
2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1
3. https://www.nlp.com/what-is-nlp/
4. https://www.mygreatlearning.com/blog/basics-of-building-an-artificial-intelligence-chatbot/
5. https://www.javatpoint.com/application-of-ai

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**I/III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ADEC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Agile and Software Project Management**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech AI&DS and CSE(BDA))

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Perform Software engineering processes.	**K2**
	CO2 Plan and manage projects	**K3**
	CO3 Apply different software testing strategies.	**K3**
	CO4 Illustrate different Agile Methodology.	**K2**
	CO5 Make use of different process of Agile Methodology.	**K3**

UNIT- I	**Software Engineering Processes**	**Periods: 9**	
Software engineering concepts – Importance of Software Project Management – Activities – Methodologies - Development activities – Software Process Models : Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Component Assembly Model -Agile Model.			**CO1**
UNIT- II	**Project Planning**	**Periods: 9**	
Software project management – Project planning – Estimation Techniques – Scheduling – Risk management – Software configuration management - Organization and Team structures – Staffing – Software Requirements specification - Design concepts.			**CO2**
UNIT-III	**Software Testing**	**Periods: 9**	
Introduction to Software testing – – Principles of Software Testing – Techniques of testing - Levels of testing- Defects – Defect Prevention Strategies – Software Testing Life Cycle.			**CO3**
UNIT-IV	**Agile Methodology**	**Periods: 9**	
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.			**CO4**
UNIT-V	**Agile Processes**	**Periods: 9**	
Lean Production – SCRUM, Crystal, Feature Driven Development – Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Ian Sommerville, “Software Engineering”, Pearson Education, Eighth edition, 2008.
3. Craig Larman, “Agile and Iterative Development–A Manager"s Guide”, Pearson Education, 2010.
4. Elisabeth Hendrickson, “Agile Testing” Quality Tree Software Inc, 2012.

Reference Books

1. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science”, Springer, 2009.
2. Roger S. Pressman, “Software Engineering: A Practitioner's Approach”, McGraw-Hill International Edition, Seventh Edition, 2009.
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Prentice Hall, 2003.
4. Object-Oriented Systems Analysis and Design, McGraw-Hill Higher Education; 4th Edition, 2010.
5. Robert C Martin, “Agile Software Development, Principles, Patents and Practices”, Prentice Hall, 2012.

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1. https://www.coursera.org/courses?query=software%20engineering
2. https://www.edx.org/learn/software-engineering
3. https://www.udemy.com/courses/development/software-engineering/
4. https://www.coursera.org/learn/agile-software-development
5. https://www.tutorialspoint.com/sdlc/sdlc_agile_model.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC05**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Game Design and Augmented Reality**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Common to M.Tech CSE and M.Tech CSE(BDA)

Prerequisite		
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Learn and understand the AR world and setting up the environment.	**K3**
	CO2 Understand the building of AR App	**K3**
	CO3 Set up the AR Solar System and Flat Tire.	**K3**
	CO4 Set up the Room Decoration with AR and AR instruction manual.	**K4**
	CO5 Develop the Poke the Ball Game.	**K5**

UNIT- I	**AUGMENT YOUR WORLD AND SETTING UP YOUR SYSTEM**	**Periods: 9**
Augmented Reality Applications - AR Development Tools and Frameworks - User Interaction in AR - AR Content Creation and Design - Social and Ethical Implications of AR.		**CO1**
UNIT- II	**BUILDING OUR AR APP AND AUGMENTED BUSINESS CARDS**	**Periods: 9**
Conceptualizing the AR Experience - Choosing the Right AR Development Platform - Designing AR User Interfaces - Integrating AR Features with Unity (or other AR Engines) - Testing and Iterating on Your AR App.		**CO2**
UNIT-III	**AR SOLAR SYSTEM AND HOW TO CHANGE A FLAT TIRE**	**Periods: 9**
Solar System Exploration in AR – Educational AR Apps for Astronomy – AR Planetarium Navigation – Augmented Reality Solar System Models – Preparation and Safety Measures – Installing the Spare Tire and Finishing the Process.		**CO3**
UNIT-IV	**AUGMENTING THE INSTRUCTION MANUAL AND ROOM DECORATION WITH AR**	**Periods: 9**
Interactive Step-by-Step Guides - Product Demos and Simulations - AR Troubleshooting and Maintenance - User Feedback and Ratings - Virtual Furniture Placement - Customizable Virtual Decor - AR Art Galleries and Displays - Seasonal and Themed Decorations.		**CO4**
UNIT-V	**POKE THE BALL GAME**	**Periods: 9**
Poke Game Mechanics - Scoring System - Levels and Challenges - Visual Design and Theme - Leaderboards and Social Features.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Micheal Lanham, "Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia" , packt Publishing, 2017.
2. Dominic Cushnan, Sean White, "Unity AR & VR by Tutorials", Razeware LLC, 2019.
3. Jonathan Linowes, "Title: ARCore by Example", Packt Publishing, 2018.

Reference Books

1. Raghav Sood, Mastering Unity 2D Game Development - Second Edition, Packt Publishing, 2018.
2. Greg Kipper, Joseph Rampolla, "Augmented Reality: An Emerging Technologies Guide to AR Publication: Syngress", 2013.
3. Daniel M. Kligler, "Beginning Windows Mixed Reality Programming: For HoloLens and Mixed Reality Headsets", Apress, 2017.
4. Jason Odom, "Mastering Unreal Technology, Volume I: Introduction to Level Design with Unreal Engine 3", Sams Publishing, 2009.
5. Palmer Luckey, Blake J. Harris, "The History of the Future: Oculus, Facebook, and the Revolution That Swept Virtual Reality", HarperCollins, 2019

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2. https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@5.1/manual/index.html
3. https://docs.unity3d.com/Packages/com.unity.xr.arkit@1.0/manual/index.html
4. https://github.com/google-ar/arcore-unity-sdk
5. https://developers.google.com/ar/develop/unity

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSEC06**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**IMAGE AND VIDEO ANALYTICS**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Common to M.Tech CSE and M.Tech CSE(BDA)

Prerequisite	No pre request needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the requirements of image processing	**K2**
	CO2 Illustrate the principles and techniques of digital image in applications related to digital imaging system	**K3**
	CO3 Demonstrate the image recognition and motion recognition	**K3**
	CO4 Understand the fundamentals of digital video processing	**K2**
	CO5 Design and Analysis of video processing in application	**K4**

UNIT- I	**Image Segmentation, Compression and Colour Image Processing**	**Periods: 9**	
Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Histogram Processing, Spatial filtering, Frequency Domain filtering - Image Segmentation –Detection of Discontinuities. - Edge Linking and Boundary Detection. - Thresholding. -Region-Based Segmentation. Image Compression – Encoder-Decoder model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, JPEG, JPEG 2000. Colour Image Processing – Colour Models, Color Transformations Color Image Smoothing and Sharpening, Color Noise Reduction, Color-Based Image Segmentation			**CO1**
UNIT- II	**Feature extraction and Texture Analysis**	**Periods: 9**	
Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction, PCA - SIFT – SURF. Texture Analysis - Concepts and classification, statistical, structural and spectral analysis.			**CO2**
UNIT-III	**Object recognition and Image Retrieval**	**Periods: 9**	
Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template-Matching. Content Based Image Retrieval - Feature based image retrieval, Object Based Retrieval			**CO3**
UNIT-IV	**Digital video processing, Segmentation and Tracking**	**Periods: 9**	
Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation - Change Detection, Background modelling, Motion Segmentation, Simultaneous Motion Estimation and Segmentation, Motion Tracking, Multi-target/Multi-camera tracking			**CO4**
UNIT-V	**Video Analysis Action Recognition**	**Periods: 9**	
Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance - Advanced Driver Assistance System			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice-Hall, 2008
2. Murat Tekalp, "Digital Video Processing", Second Edition, Prentice Hall, 2015.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, 4nd edition, Thomson Learning, 2013

Reference Books

1. Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press,2011
2. Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", Tsinghua University Press, 2009.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012
4. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010
5. Boguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice", Wiley 2013

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1. https://www.sciencedirect.com/topics/computer-science/video-analytics
2. https://dl.acm.org/doi/10.1145/3576935
3. https://cloudinary.com/documentation/video_analytics
4. https://www.happiestminds.com/services/image-processing-text-audio-video-analytics/
5. https://ieeexplore.ieee.org/document/9362900

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE315**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Graphs – Algorithms and Mining**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of graph and algorithms	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basic concepts of graphs theory.	**K2**
	CO2 Apply the graph mining algorithms to analyze large-scale datasets on various domain	**K4**
	CO3 Formulate and solve graph-related problems	**K3**
	CO4 Analyze different models & techniques for web mining	**K3**
	CO5 Evaluate the different real time applications algorithms for graph analytics.	**K4**

UNIT- I	**Introduction to graphs**	**Periods: 9**	
Graphs- Graph Analytics and Algorithms-Graph Processing, Databases, Queries, and Algorithms, Graph Types and Structures, Random, SmallWorld, Scale-Free Structures, OLTP and OLAP-Graph Algorithms- Graph Analytics Use Cases-Platform Considerations, Processing Considerations, Representative PlatformsSelecting Our Platform, Apache Spark			**CO1**
UNIT- II	**Path Finding and Graph Search Algorithms**	**Periods: 9**	
Importing the Data into Apache Spark, Importing the Data into Neo4j, Breadth First Search with Apache Spark, Shortest Path , Shortest Path (Weighted) with Apache Spark, All Pairs Shortest Path, Single Source Shortest Path, Minimum Spanning Tree, Random Walk			**CO2**
UNIT-III	**Centrality Algorithms**	**Periods: 9**	
Centrality Algorithms Example Graph Data: The Social Graph, Degree Centrality, Closeness Centrality, Between ness Centrality, PageRank. Community Detection Algorithms Example Graph Data: The Software Dependency Graph, Triangle Count and Clustering Coefficient, Strongly Connected Components, Connected Components			**CO3**
UNIT-IV	**Graph Algorithms in Practice**	**Periods: 9**	
Analyzing Yelp Data with Neo4j, Analyzing Airline Flight Data with Apache Spark, Graphs and Machine Learning in Practice: Link Prediction- Tools and Data, Importing the Data into Neo4j,The Coauthor ship Graph, Creating Balanced Training and Testing Datasets, How We Predict Missing Links, Creating a Machine Learning Pipeline, Predicting Links: Basic Graph Features, Predicting Links: Triangles and the Clustering Coefficient, Predicting Links: Community Detection			**CO4**
UNIT-V	**Recent Trends**	**Periods: 9**	
Recent Trends in the Domain of Graph Mining			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Graph Algorithms by Mark Needham Amy E. Hodler Publisher(s): O'Reilly Media, Inc.
2. Data minining–Concepts and Techniques by J. Han and M. Kamber 2 nd Edition, Morgan kaufman Publishers, 2006
3. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu Springer publishing, 2009

Reference Books

1. Qi Xuan, Yong Min, Zhongyuan Ruan, “Graph Data Mining: Algorithm, Security and Application (Big Data Management)”, Springer Verlag, Singapore, 2021
2. Albert-László Barabási, “Network Science”, Cambridge University Press,2016.
3. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science” Prentice Hall India Learning Private Limited, 1979
4. Tim Roughgarden, “*Algorithms Illuminated”,* Soundlikeyourself Publishing, 2018
5. William L. Hamilton, Rex Ying, and Jure Leskovec, “*Graph Representation Learning”,* Springer International Publishing, 2020.

Web References

1. https://www.youtube.com/watch?v=v9VL0fPu2sQ
2. https://www.youtube.com/watch?v=IJdQrx2zPFE
3. https://www.youtube.com/playlist?list=PLrmLmBdmIlpu2f2g8ltqaaCZiq6GJvl1j
4. https://www.youtube.com/watch?v=Fs5ax_qFLXM
5. https://hpi.de/fileadmin/user_upload/fachgebiete/mueller/courses/graphmining/2017/01-Introduction.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE316**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Real-Time Systems**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	No pre request needed							

Course Outcomes		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understanding Real time systems	**K2**
	CO2	Understanding Multi processor scheduling	**K2**
	CO3	Illustrate Real time communications	**K3**
	CO4	Analyze Real time databases	**K3**
	CO5	Analyze Real time modeling and case studies	**K3**

UNIT- I	**INTRODUCTION TO TASK SCHEDULING**	**Periods: 9**	
Introduction - Issues in Real Time Computing, Structure of a Real Time System, Task classes, Performance Measures for Real time Systems, Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms, RM algorithm with different cases-Priority ceiling precedence constraints- using of primary and alternative tasks.			**CO1**
UNIT- II	**UNI AND MULTI PROCESSOR SCHEDULING**	**Periods: 9**	
Uniprocessor scheduling of IRIS tasks, Task assignment, Utilization balancing – Next fit- Bin packing- Myopic off-line - Focused addressing and bidding- Buddy strategy- Fault Tolerant Scheduling. -Aperiodic scheduling - Spring algorithm, Horn algorithm- Bratley. – Sporadic scheduling.			**CO2**
UNIT-III	**REAL TIME COMMUNICATION**	**Periods: 9**	
Introduction – VTCSMA – PB CSMA- Deterministic collision resolution protocol- DCR for multi packet messages- dynamic planning based- Communication with periodic and aperiodic messages.			**CO3**
UNIT-IV	**REAL TIME DATABASES**	**Periods: 9**	
Basic Definition, Real time Vs General purpose databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time System.			**CO4**
UNIT-V	**REAL-TIME MODELING AND CASE STUDIES**	**Periods: 9**	
Petrinets and applications in real-time modeling, Air traffic controller system – Distributed air defense system.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. C.M. Krishna, Kang G. Shin, “Real Time Systems”, Tata McGraw - Hil, 2010.
2. Giorgio C. Buttazzo , “Hard real-time computing systems: predictable scheduling algorithms and applications” , Springer, 2008.
3. C. Siva Ram Murthy, G. Manimaran, “Resource management in real-time systems and networks”, PHI, 2009

Reference Books

1. Rajib Mall, “Real-Time Systems Theory and Practice”, Pearson Education, India, 2007.
2. Jane W.S. Liu, “Real-Time Systems”, Prentice Hall, USA, 2000.
3. Phillip. A. Laplante , “Real-Time Systems Design and Analysis”, second edition, PHI, 2005.
4. Raj Kamal, “ Embedded Systems”, Tata McGraw Hill, India, third edition, 2005.
5. Stuart Bennet, “Real-Time Computer Control”, 2nd Edn. Pearson Education. 2008.

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1. https://www.geeksforgeeks.org/real-time-operating-system-rtos/
2. https://www.sciencedirect.com/topics/computer-science/real-time-systems
3. https://www.geeksforgeeks.org/real-time-systems,application
4. https://www.intel.com/content/www/us/en/robotics/real-time-systems.html
5. https://digilent.com/reference/learn/courses/unit-2/start

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE317**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Social Network Analysis**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	**No pre request needed**	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understanding Semantic Web	**K2**
	CO2 Illustrate Ontology and their role in the Semantic Web	**K3**
	CO3 Make use of Extracting Evolution of Web Community	**K2**
	CO4 Understanding and predicting human behavior and privacy issues.	**K2**
	CO5 Analyze virtualization and applications of social networks	**K3**

UNIT- I	**Introduction**	**Periods: 9**	
Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis			**CO1**
UNIT- II	**Modelling, Aggregating and Knowledge Representation**	**Periods: 9**	
Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.			**CO2**
UNIT-III	**Extraction and Mining Communities in Web Social Networks**	**Periods: 9**	
Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.			**CO3**
UNIT-IV	**Predicting Human Behavior and Privacy Issues**	**Periods: 9**	
Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.			**CO4**
UNIT-V	**Visualization and Applications of Social Networks**	**Periods: 9**	
Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Peter Mika, —Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, —Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.
3. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking Techniques and applications, First Edition, Springer, 2011.

Reference Books

1. Dion Goh and Schubert Foo,"Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
2. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
3. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web",Springer, 2009
4. Tanmoy Chakraborty, "Social Network Analysis", Wiley, 2021
5. John Scott, "Social Network Analysis", Fourth Edition, SAGE Publications Ltd, 2017.

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1. https://www.youtube.com/watch?v=lnLW6ITFY3M
2. https://www.youtube.com/watch?v=v3JaWbAdTTg
3. https://www.youtube.com/watch?v=QJFHgFW7GUs&list=PL1M5TsfDV6Vs7tnHGNgowEUwJW-O8QVp5&index=2
4. https://www.youtube.com/watch?v=2ZHuj8uBinM
5. https://www.ncrm.ac.uk/resources/video/RMF2012/whatis.php?id=f37f16c

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE318**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Analytics of Things**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of IoT	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the specific challenges in applying data analytics techniques over IoT data.	**K2**
	CO2 Will know IoT network architecture and design.	**K2**
	CO3 Analyze Smart objects and connecting smart objects	**K3**
	CO4 Analyze various IoT networking protocols.	**K3**
	CO5 Apply IoT analytics for cloud and data science for IoT analytics.	**K4**

UNIT- I	**IoT Analytics, Challenges and Network Architectures**	**Periods: 9**	
IoT analytics: Defining Analytics, Defining Internet of Things, The concepts of constrained - IoT challenges: the Data volume, Problem with time and space, Data quality, Analytics Challenges -Business value concerns. Drivers behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.			**CO1**
UNIT- II	**The Things in IoT and Connecting Smart Objects**	**Periods: 9**	
Sensors, Actuators, and Smart Objects, Sensor Networks, Communications Criteria, Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained-Node Networks, IoT Access Technologies, IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, LoRaWAN.			**CO2**
UNIT-III	**IoT Networking Protocols**	**Periods: 9**	
IoT networking data messaging protocols, Message Queue Telemetry Transport (MQTT), Hyper-Text Transport Protocol (HTTP), Constrained Application Protocol (CoAP), Data Distribution Service (DDS).			**CO3**
UNIT-IV	**Data Science for IoT Analytics**	**Periods: 9**	
Machine learning (ML), Feature engineering with IoT data, Validation methods, Understanding the bias– variance tradeoff, Comparing different models to find the best fit using R, Random forest models using R, Anomaly detection using R.			**CO4**
UNIT-V	**IoT Analytics for the Cloud**	**Periods: 9**	
Building elastic analytics, Elastic analytics concepts, designing for scale, Cloud security and analytics, The AWS overview, Microsoft Azure overview. Contemporary Issues			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Andrew Minteer , Analytics for the Internet of things, Packt publishing 2017.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
3. Adeel Javed, “Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications”, 1st Edition, Apress, 2016.

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1. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.
2. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things Principles and Paradigms, Morgan Kaufmann, 1st edition, 2016.
3. Marco Schwartz, Internet of Things with Arduino Cookbook, Packt Publishing,2016.
4. Hwaiyu Geng,” Internet of Things and Data Analytics Handbook”, Wiley, 2016.
5. Rohit Sharma, Gwanggil Jeon, Yan Zhang, “Data Analytics for Internet of Things Infrastructure”, Springer, 2023.

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2. https://www.ibm.com/blogs/internet-of-things/what-is-the-iot/
3. https://www.geeksforgeeks.org/edge-computing/
4. https://www.i-scoop.eu/internet-of-things-guide/edge-computing-iot/
5. https://digimat.in/nptel/courses/video/106105166/L02.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science Engineering (Big Data Analytics)**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23BDE319**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**User Interface/ User Experience Design**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	No pre request needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Organize information about users into useful summaries with affinity diagrams	**K2**
	CO2 Learn and appreciate the skill of sketching as a process for user experience design	**K2**
	CO3 Demonstrate skills for low-fidelity prototyping and describe the strengths and weaknesses of a variety of prototyping methods	**K3**
	CO4 Understand the differences between usability and user experience	**K2**
	CO5 Analyze an interaction design problem and propose a user-centered process, justifying the process and identifying the trade-offs	**K4**

UNIT- I	**Introduction to UI Pattern**	**Periods: 9**	
Users interaction with design patterns – Following universal design conventions – Applying empathy to UI design patterns – Patterns working - Expectations reinforce themselves - Deadline-Busting Communication – importance of the usage of patterns – Planning a pattern - Thinking Through the Process - Patterns Take Guesswork Off of Developers' Plates - User Testing.			**CO1**
UNIT- II	**Prototyping and Applying UI Design Patterns**	**Periods: 9**	
Explaining the grey box - Pattern Libraries Are Prototyping Shortcuts - Reusable elements - Patterns and Prototypes Work Together - Building a Pattern Library - Riffing on Design Patterns - Tweaking Pattern Styles - Going forward - Formatting Data - Getting input – Navigation – Teasers.			**CO2**
UNIT-III	**Introduction to UX Design**	**Periods: 9**	
Introduction to UX – The five Main Ingredients of UX – User Perspective – The Three whats of user perspective – Solutions versus Ideas – The Pyramid – User Goals and Business goals – UX is a process – Gathering Requirements – Building Consensus.			**CO3**
UNIT-IV	**Design as Dream Catcher**	**Periods: 9**	
Introduction - Case Study: Apple, Design and Business - The Bossy Rule - A Snapshot of Today - The Role of Design - A Sketch of the Process - The Cycle of Innovation - The Question of Design - The Anatomy of Sketching - Clarity is not always the Path to Enlightenment - The Larger Family of Renderings - Experience Design vs. Interface Design - Sketching Interaction - Sketches are not Prototypes - The Object of Sharing - Annotation: Sketching on Sketches - Design Thinking & Ecology.			**CO4**
UNIT-V	**Stories of Methods and Madness**	**Periods: 9**	
Introduction - The Wonderful Wizard of Oz - Chameleon: From Wizardry to Smoke-and-Mirrors - Le Bricolage: Cobbling Things Together - It was a Dark and Stormy Night - Visual Story Telling Simple Animation - Shoot the Mime - Sketch-a-Move - Extending Interaction: Real and Illusion - The Bifocal Display - Video Invisionment - Interacting with Paper.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ben Gremillion, Jerry Cao and Kamil, "Tactical UI Design Patterns: Handbooks to Faster Design", 2015.
2. Joel Marsh, "UX for Beginners, A Crash Course in 100 Short Lessons", O'Reilly Media; First edition, 2015.
3. Buxton, B. "Sketching User Experiences: Getting the Design Right and the Right Design", Morgan Kaufmann, 2007.

Reference Books

1. Jesmond J. Allen, James J. Chudley, "Smashing UX Design: Foundations for Designing Online User Experiences", Wiley, First Edition, 2012.
2. Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt, Bill Buxton, "Sketching User Experiences: The Workbook", Morgan Kaufmann, First Edition, 2011.
3. Alan Cooper, "The Essential of User Interface Design", Wiley – Dream Tech Ltd., 2002.
4. Wilbent. O. Galitz , "The Essential Guide To User Interface Design", John Wiley& Sons, 2001.
5. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.

Web References

1. https://uxdesign.cc/how-to-become-a-ui-ux-designer-self-taught-8a511170fd7c
2. https://careerfoundry.com/en/blog/ux-design/the-difference-between-ux-and-ui-design-a-laymansguide/
3. https://uxplanet.org/what-is-ui-vs-ux-design-and-the-difference-d9113f6612de

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	-	-	1	-	1	1	1
2	2	2	2	3	2	-	1	2	1
3	1	1	2	2	-	-	1	2	1
4	1	1	-	3	2	-	1	2	1
5	3	2	2	2	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PA**			*End Semester Exam Type: **LE**			
Course Code	**P23BDW301**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project Phase - I**	**-**	**-**	**12**	**6**	**50**	**50**	**100**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

The student is required to undertake the project phase I during the third semester and the same shall be continued in the 4 th semester (Phase II). Phase I consist of preliminary thesis work, three reviews of the work and the submission of preliminary report. First review shall highlight the topic, objectives and origin of problem, second review shall highlight, Literature survey, methodology and expected results. Third review shall evaluate the progress of the work, preliminary report and scope of the work which shall be completed in the 4 th semester. Also the evaluation of project phase - I shall be done externally.

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PA**			*End Semester Exam Type: -			
Course Code	**P23BDW302**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Internship**	**-**	**-**	**-**	**2**	**100**	**-**	**100**

Students should undergo training or internship during summer / winter vacation at Industry/ Research organization / University (after due approval from the Programme Academic Coordinator and Department Consultative Committee (DCC). In such cases, the internship/training should be undergone continuously (without break) in one organization. Normally no extension of time is allowed. However, DCC may provide relaxation based on the exceptional case. The students are allowed to undergo three to four weeks internship in established industry / Esteemed institution during vacation period. The student should give presentation and submit report to DCC. The Internship is assessed internally for 100 marks.

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **AEC**			*End Semester Exam Type: -			
Course Code	**P23BDC301**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**NPTEL/SWAYAM/MOOC**	**-**	**-**	**-**	**-**	**100**	**-**	**100**

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator and Subject Experts. Students have to complete relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**IV**	Course Category : **PA**			*End Semester Exam Type: **LE**			
Course Code	**P23BDW403**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project Phase - II**	**-**	**-**	**24**	**12**	**50**	**50**	**100**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

Project phase II is a continuation of project phase I which started in the third semester. There shall be three reviews in the fourth semester, first in the beginning of the semester, second in the middle of the semester and the Third at the end of the semester. First review is to evaluate the progress of the work and planned activity; second review shall be presentation and discussion. Third review shall be a presubmission presentation before the evaluation committee to assess the quality and quantity of the work done. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper shall be prepared for possible publication in journals or conferences. The technical paper shall be submitted along with the thesis. The final evaluation of the project shall be done externally.