



JAIDEV EDUCATION SOCIETY'S
J D COLLEGE OF ENGINEERING AND MANAGEMENT
KATOL ROAD, NAGPUR

Website: www.jdcoem.ac.in E-mail: info@jdcoem.ac.in

An Autonomous Institute, with NAAC "A" Grade

Affiliated to DBATU, RTMNU & MSBTE Mumbai

Department of Information Technology & CSE (Data Science)

"Progress Beyond Excellence"

2024-25



Course Structure and Syllabus (Autonomous)

For

B.Tech. Computer Science & Engineering (Data Science)



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VISION AND MISSION OF INSTITUTE

VISION

To be a centre of excellence imparting professional education satisfying societal and global needs.

MISSION

Transforming students into life long learners through quality teaching, training and exposure to concurrent technologies. Fostering conducive atmosphere for research and development through well-equipped laboratories and qualified personnel in collaboration with global organizations.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

PEOs	ATTRIBUTES
PEO1	Students will have In-depth knowledge of trending technologies ,effective communication skills, lifelong learning with leadership qualities in order to work in any multidisciplinary areas in a team or individually.
PEO2	Students will be able to interpret and analyze the requirements of the software design and development to provide efficient engineering solutions with novel product designs within the jurisdiction of humanity and social constraints
PEO3	Students will have the attitude to pursue higher studies or research work or initiate entrepreneurial activity

PROGRAM OUTCOMES (PO's)

POs	ATTRIBUTES
1	An Understanding of IT architecture, software and hardware concepts, functionalities and applications
2	An Ability to design, develop and test computer programs involving various algorithms, methodology and programming languages.
3	Competency of business domains and functional processes that employ IT systems and applications
4	Practical use of communication protocols and their applications in the field of internet and world wide web.
5	Sound understanding of fundamentals of computer as the central enabling platform for information management in 21st century.
6	An Ability to develop, integrate, maintain and innovate software applications deployed in various multi-disciplinary domains.
7	Thought leadership to design and implement practical solutions for global industry needs.
8	An Acumen to embrace and adopt futuristic IT technological developments.
9	Sound knowledge of entrepreneurship traits to succeed.
10	Adoption of practices that are ethical ensuring transparency and accountability.
11	Capability to provide solutions that are socially empowering and environment friendly.
12	Effective communication and collaboration techniques with stakeholders to achieve best results.

PROGRAM SPECIFIC OUTCOMES(PSOS):

PSO1: The ability to understand, analyze and develop computer programs in the areas related to Algorithms, system software, multimedia ,web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity

PSO2: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: The ability employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, lifelong learning & a zest for higher studies and also acts as good citizen by inculcating in them

Recommendations for conducting one theory course of curriculum through online Teaching / Learning

1. Only Swayam/NPTEL platform is allowed.
2. One defined subject per semester in online mode and BOS should declare that one subject for online mode based on availability of NPTEL offering before commencement of the semester.
3. Student will be allowed to appear for NPTEL/Institute level/University Examination as applicable.
4. In order to ensure learning, NPTEL lectures to be telecast in the class by including it in regular timetable if required.
5. 75% assignments submission is mandatory for these online classes as well as regular lecture attendance.
6. One faculty to be allotted for this subject, who will discuss and solve student's doubts. Allot 3hrs/weekload to teacher who is allotted to work as facilitator of online course.
7. For Autonomy Students: For online mode the student should submit all assignment given by NPTEL then his/her score has weightage of 40% for CA & MSE. And if student clear the NPTEL final exam and producing certificate then 60% weightage should be given as ESE, otherwise he/she has to appear for Makeup exam of Institute.

If student cannot enroll for NPTEL then he/she has to study online videos / material and these students should appear for Mid Semester, CA-I, CA-II and End sem exams of the Institute.

8. For DBATU students: For online mode he has to appear for CA-I, CA-II, Mid sem exam of the institute and End sem exam of University.

If student can't enroll for NPTEL then he/she has to study online videos / material and these students should appear for Mid Semester, CA-I, CA-II of the institute and End sem exams of the University.

10. If the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

This system will ensure real learning; avoid any problem arising due to cancellation of NPTEL exam as it happened in this semester. At least for first year and in the unpredictable situation of covid pandemic these provisions will avoid any last moment chaos.

COURSE STRUCTURE AND SYLLABUS

For

B.Tech. CSE (Data Science)

Curriculum for Semester-V [Third Year]

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC	DS5T001	Data Warehousing & Mining	3	0	0	20	20	60	100	3
2	PCC	DS5T002	Software Project Management	2	1	0	20	20	60	100	3
3	PCC	DS5T003	Cloud Computing	3	0	0	20	20	60	100	3
4	PEC	DS5E001	Elective - I	3	0	0	20	20	60	100	3
5	OEC	DS5OE01	Open Elective - I	3	1	0	20	20	60	100	4
6	MC	DS5T004	Innovation & Entrepreneurship Development	2	0	0	15	10	25	50	Audit
7	PCC	DS5L005	Data Mining tool & Techniques (Lab)	0	0	2	60	0	40	100	1
8	PCC	DS5L006	R programming for Data Science (Lab)	0	0	2	60	0	40	100	1
9	PCC	DS5L007	Web Technology Lab	0	0	2	60	0	40	100	1
10	PROJECT	DS5P008	Field Training/Industrial Visit	0	0	2	30	0	20	50	1
11	PROJECT	DS5P009	Mini Project	0	0	0	30	0	20	50	1
				16	1	8	355	110	485	950	20

Elective 1

- R for Data Science
- TCP/IP
- IOT Architecture & Computing
- Data & Virtual Analysis in AI

Open Elective 1

- Business Intelligence in AI

Program: B.Tech. in CSE (Data Science) Autonomous Syllabus

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5T001	Data Warehousing & Mining	3	0	0	3
Prerequisites for the course						
1	Basic knowledge of databases and SQL					

Prior Reading Material/useful links

1.	https://www.geeksforgeeks.org/data-warehousing/
2.	https://www.simplilearn.com/ data-warehousing-article
3.	https://kanchiuniv.ac.in/coursematerials/Data%20Warehousing%20Vijaya%20Raghavan.pdf

Sr. No	Course Outcome number	CO statement
1	CO1	Understand the functionality of the various data mining and data warehousing component.
2	CO2	Appreciate the strengths and limitations of various data mining and data warehousing models
3	CO3	Explain the analyzing techniques of various data
4	CO4	Describe different methodologies used in data mining and data ware housing.
5	CO5	Compare different approaches of data ware housing and data mining with various technologies.

Syllabus:

Course Contents		Hours
Unit 1:	Data Warehouse: Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; FactLess-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP..	[6 Hrs]
Unit 2:	Introduction to Data Mining: Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binaryzation , Data Transformation; Measures of similarity and dissimilarity-Basics.	[6 Hrs]
Unit 3:	Association Rules: Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set..	[6 Hrs]
Unit 4:	Classification: General Approaches to solving a classification problem, Classification techniques, Decision trees-Decision Tree Construction, Methods for expressing attribute test conditions, Measures for Selecting the Best split, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification-Algorithm and characteristics.	[7Hrs]
Unit 5:	Clustering: Problem Definition, Clustering overview, Evaluation of clustering algorithms, Partitioning clustering K-Means Algorithm, K-Means Additional	[7Hrs]

	Issues, PAM Algorithm, Hierarchical Clustering-Algorithm- Agglomerative Methods and Divisive Methods, Basic Agglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and weakness, Outlier Detection	
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Total 38 Hours

Text Books	
1.	Jiawei Han, Micheline Kamber and Jian Pei“Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.
2.	"Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals", Paulraj Ponniah:

Reference Books	
1.	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
2.	K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3.	G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.

Useful Links	
1	https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/10082021/DIP%20DIGITAL%20NOTES.pdf
2	https://kanchiuniv.ac.in/coursematerials/Data%20Warehousing%20Vijaya%20Raghavan.pdf
3	https://www.cet.edu.in/noticefiles/272_Data-Warehousing.pdf

Program: B.Tech. in CSE (Data Science)

Teaching Scheme for 5th Semester (CSE-DS)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5T002	Software Project Management	2	1	0	3
Prerequisites for the course						
1	Basic Understanding of Software Development					

2	Ability to Manage Resources
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Prior Reading Material/useful links	
1.	https://www.geeksforgeeks.org/ Software-Project-Management/
2.	https://www.simplilearn.com/Software-Project-Management-article

Sr. No	Course Outcome number	CO statement
1	CO1	Apply project management concepts and techniques to an IT project
2	CO2	Identify issues that could lead to IT project success or failure.
3	CO3	Explain project management in terms of the software development process.
4	CO4	Describe the responsibilities of IT project managers.
5	CO5	Apply project management concepts through working in a group as team leader

Syllabus:

Course Contents		Hours
Unit 1:	Conventional Software Management: The waterfall Model, Conventional Software Management Performance, Improving Software Processes. Improving Team Effectiveness, Improving Automation, Achieving Required Quality. Principles of Modern Software Management.	[4 Hrs]
Unit 2:	Life Cycle Phases: Engineering and Production Stages Inception, Elaboration, Construction, Transition phases, Evolution of Software Economics: software Economics. Pragmatic Software Cost Estimation. Improving Software Economics: Reducing Software Product Size	[5 Hrs]
Unit 3:	Artifacts of the Process: The Artifact Sets. Management Artifacts. Engineering Artifacts, Programmatic Artifacts. Model Based Software Architectures: A Management Perspective and Technical Perspective.	[5 Hrs]
Unit 4:	Flows of the Process: Software Process Workflows. Inter Trans Workflows. Checkpoints of the Process: Major Mile Stones. Minor Milestones, Periodic Status Assessments. Interactive Process Planning: Work Breakdown Structures, Planning Guidelines, Cost and Schedule Estimating. Interaction Planning Process.	[5Hrs]
Unit 5:	Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, and Evolution of Organizations. Process Automation: Building Blocks, the Project Environment. Project Control and Process Instrumentation.	[5Hrs]

Total 38 Hours

Text Books	
1.	Richard H.Thayer." Software Engineering Project Management", 1997, IEEE Computer Society.
2.	Shere K.D.: "Software Engineering and Management", 1998, PHI.

Reference Books	
1.	S.A. Kelkar, "Software Project Management: A Concise Study", PHI.
2.	Hughes Cotterell, "Software Project Management", 2e, TMH. 88 3. Kaeron Conway, "Software Project Management from Concept to D

Useful Links	
1.	https://www.geeksforgeeks.org/ Software-Project-Management/
2.	https://www.simplilearn.com/Software-Project-Management-article

Program: B.Tech. in CSE(Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5T003	Cloud Computing	3	0	0	3

Prerequisites for the course	
1	Basic knowledge of computer networks

2	Operating Systems
3.	Programming Concepts.

Prior Reading Material/useful links	
1.	https://www.cs.cmu.edu/~hnl/documents/cloud-computing-virtualization/notes.pdf
2.	https://news.vidyaacademy.ac.in/wp-content/uploads/2019/11/NotesOnCloudComputingVirtualization-1.pdf
3.	https://github.com/dair-ai/CCV-Course-Notes

COURSE OUTCOMES:

After learning the course the student will be able:

Sr. No	Course Outcome number	CO statement
1	CO1	Demonstrate a solid understanding of the fundamental concepts, principles, and characteristics of cloud computing.
2	CO2	Create, configure, and manage virtual machines and virtual networks using hypervisor and virtualization management tools.
3	CO3	Manage, and monitor cloud resources using cloud management consoles, APIs, and command-line interfaces.
4	CO4	Design, deploy, and manage cloud infrastructure components such as virtual machines, containers, and storage services.
5	CO5	Apply tools and techniques for monitoring resource utilization, identifying cost-saving opportunities, and implementing cost-control measures.

Syllabus:

Course Contents		Hours
Unit 1:	Definition and Evolution of Cloud Computing, Characteristics of Cloud Computing, Advantages and Challenges of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Community).	[7 Hrs]
Unit 2:	Overview of Virtualization Concepts, Types of Virtualization (Server, Desktop, Network, Storage), Hypervisor Technologies (Type 1 vs. Type 2), Virtual Machine Management (Creation, Deployment, Migration), Containerization Technologies (Docker, Kubernetes).	[7 Hrs]

Unit 3	Virtualized Infrastructure in Cloud Computing, Software-Defined Networking (SDN) and Network Virtualization, Storage Virtualization and Management, Server Virtualization and Resource Allocation, Scalability and Elasticity in Cloud Infrastructure	[7 Hrs]
Unit 4:	Scalable Architectures for Cloud Computing, High Availability and Fault Tolerance in Cloud Environments, Microservices Architecture and its relevance to Cloud Computing, Cloud-native Development Principles, DevOps practices in Cloud Environments.	[6Hrs]
Unit 5:	Security Challenges in Cloud Computing, Identity and Access Management (IAM), Data Encryption and Key Management, Network Security in the Cloud (Firewalls, VPNs), Compliance and Regulatory Considerations.	[6Hrs]

Text Books

1.	"Cloud Computing: Concepts, Technology & Architecture", Thomas Erl et al. 1st Edition, May 2013.
2.	Mastering VMware vSphere" by Nick Marshall et al., August 2015.

Reference Books

1.	"Cloud Computing: Theory and Practice", Dan C. Marinescu and Rajkumar Buyya
2.	Virtualization: A Manager's Guide", Dan Kusnetzky and Aditya Yadav

Useful Links

https://www.cs.cmu.edu/~hn1/documents/cloud-computing-virtualization/notes.pdf
https://news.vidyaacademy.ac.in/wp-content/uploads/2019/11/NotesOnCloudComputingVirtualization-1.pdf
https://github.com/dair-ai/CCV-Course-Notes

Program: B.Tech. in CSE(Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5E001A	R for Data Science	3	0	0	3

Prerequisites for the course

1.	Knowledge of C Programming and Data Structure
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Prior Reading Material/useful links	
1	Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), R Programming, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf .

Course Outcomes:

Sr. No	Course Outcome number	CO statement
1	CO1	Understand the basics of Fundamentals of R.
2	CO2	Understands the loading, retrieval techniques of data.
3	CO3	Understand how data is analysed and visualized using statistic functions.
4	CO4	Ability to deal with complex Objects
5	CO5	Demonstrate on basics statistical data analysis with examples.

Syllabus :-

Course Contents		
Unit I	Introduction to R & Data Science:What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments –Installing a R Package, Special Values functions : NA, Inf and–inf.	[6 Hrs]
Unit II	R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables – R Operators: Arithmetic Operators, Relational Operators,Logical Operator, Assignment Operators, Miscellaneous Operators - R Decision Making: if statement, if – else statement, if– else if statement, switch statement – R Loops: repeat loop, while loop, for loop – Loop control statement: break statement, next statement.	[6 Hrs]
Unit III	R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data: substr(),strsplit(), paste(), grep(), toupper(), tolower() -	[6 Hrs]
Unit IV	Size of List,Merging Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix,Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements,	[7Hrs]
Unit V	Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge().	[7Hrs]

Text Books

1.	Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017, ISBN : 978-93-5260-455-5.
2.	Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN:978-93-5260-524-8.

Reference Books	
1.	Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8

Useful Links	
1.	Coursera.org/learn/r-programming
2.	https://www.r-project.org/about.html
3.	https://www.programiz.com/r

Program: B.Tech. in CSE(Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5E001B	TCP/IP	3	0	0	3

Prerequisites for the course	
1.	Computer Networks

Prior Reading Material/useful links	
1.	Charles .E. Perkins, “Ad Hoc Networking”, Pearson Education, 2008.
2.	C.K.Toh, “Ad Hoc Mobile Wireless Networks-Protocols and Systems”, Pearson Education, 2009.

Course Outcomes:

Sr. No	Course Outcome	CO statement
1	CO1	Design their own wireless network.
2	CO2	Evaluate the existing network and improve its quality of service.
3	CO3	Choose appropriate protocol for various applications.
4	CO4	Examine security measures present at different level.
5	CO5	Analyze energy consumption and management.

Syllabus:

Course Contents		Hours
Unit I	Teaching Hours Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, MAC Protocols that Use Directional Antennas.	[6Hrs]
Unit II	Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols	[6 Hrs]
Unit III	Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols	[6 Hrs]
Unit IV	Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer, Security in Ad-hoc Wireless Networks, Network Security Attacks, Key Management and Secure routing Ad-hoc Wireless Networks.	[7 Hrs]
Unit V	Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks.	[7 Hrs]

Text Books	
1.	C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011

Reference Books	
1.	Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2.	Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.

Useful Links	
1	https://www.inmiit.ac.in/Computer%20Science%20&%20Engineering/Rajbir_MANETCourseStructure.pdf
2	https://study.com/academy/topic/ad-hoc-wireless-networks.html
3	https://www.inspireignite.com/mh/dlo8013-adhoc-wireless-network-syllabus-for-cs-8th-sem-2019-pattern-mumbai-university-department-level-optional-course-4/

Program: B.Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5E001C	IoT Architecture & Computing	3	0	0	3
	Prerequisites for the course					
1	Basic computer science engineering No prior Internet of Things knowledge required					

Prior Reading Material/useful links	
1.	https://www.geeksforgeeks.org/iot/
2.	https://www.simplilearn.com/cloud_computing-article

Sr. No	Course Outcome number	CO statement
1	CO1	Describe the programmer's model.
2	CO2	Understand Application Programming Interface (API) and Cloud Deployment Models
3	CO3	Analysis and evaluate the data received through sensors in IOT.
4	CO4	Determine the right sensors and communication protocols to use in a particular IoT system.
5	CO5	Choose the appropriate protocol for communication between IoT

Syllabus:

Course Contents		Hours
Unit 1:	Cloud Computing: Definition, roots of cloud computing, characteristics, cloud architecture, deployment models, service models. Virtualization: Benefits & drawbacks of virtualization, server virtualization, virtualization of - operating system, platform, CPU, network, application, memory and I/O devices etc.	[7 Hrs]
Unit 2:	Cloud Computing Service Platforms – Compute services, storage services, database services, application services, queuing services, e-mail services, notification services, media services, content delivery services, analytics services, deployment & management services, identity & access management services and their case studies. Security in cloud computing: issues, threats, data security and information security.	[6 Hrs]
Unit 3:	Internet of Thing (IoT): Overview, conceptual framework, architecture, major components, common applications Design principles for connected devices: Modified OSI Model for IoT/M2M systems, ETSI M2M Domains and High-level capabilities, wireless communication technologies - NFC, RFID, Bluetooth BR/EDR and Bluetooth low energy, ZigBee, WiFi, RF transceiver and RF modules. Data enrichment, data consolidation & device management at gateway.	[6 Hrs]
Unit 4:	Design principles for web connectivity: web communication protocols for connected devices: constrained application protocol, CoAP Client web connectivity, client authentication, lightweight M2M communication protocol. Message communication protocols for connected devices - CoAP-SMS, CoAP-MQ, MQTT, XMPP. IoT privacy, security and vulnerabilities and their solutions.	[6Hrs]

Unit 5:	Application of IoT & Cloud: IoT and cloud integration, Application development and cloud processing, Security and Privacy for IoT/Cloud Computing.	[7Hrs]
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Text Books	
1.	"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz:
2.	"IoT Analytics: Strategy and Implementation" by Zhongjie Shen et al.

Reference Books	
1.	"Designing Connected Products: UX for the Consumer Internet of Things" by Claire Rowland et al.

Useful Links	
1.	Online tutorials and documentation for cloud platforms (AWS, Azure, Google Cloud)
2.	Research papers and articles on IoT and data analytics
3.	Open-source IoT platforms and tools (e.g., Raspberry Pi, Arduino)

Program: B.Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5E001D	Data & Virtual Analysis in AI	3	0	0	3
	Prerequisites for the course					
1	Basic statistics and Maths, Python programming					

Prior Reading Material/useful links	
1.	https://www.geeksforgeeks.org/ai
2.	https://www.simplilearn.com/ visualization-article

Sr. No	Course Outcome number	CO statement
1	CO1	Comprehend basics of data analytics and visualization.
2	CO2	Apply various regression models on given data set and perform prediction.
3	CO3	Demonstrate advance understanding of Time series concepts and analysis of data using various time series models.
4	CO4	Analyze Text data and gain insights.
5	CO5	Experiment with different analytics techniques and visualization using R.

Syllabus:

Course Contents		Hours
Unit 1:	Introduction to Data analytics and life cycle: Data Analytics Lifecycle overview: Key Roles for a Successful Analytics, Background and Overview of Data Analytics Lifecycle.	[7 Hrs]
Unit 2:	Introduction to simple Linear Regression: The Regression Equation, Fitted value and Residuals, Least Square Introduction to Multiple Linear Regression: Assessing the Model, Cross-Validation, Model Selection and Stepwise Regression, Prediction Using Regression Logistic Regression: Logistic Response function and logit, Logistic Regression and GLM, Generalized Linear model, Predicted values from Logistic Regression, Interpreting the coefficients and odds ratios, Linear and Logistic Regression: similarities and Differences, Assessing the models.	[6 Hrs]
Unit 3:	Overview of Time Series Analysis Box-Jenkins Methodology, ARIMA Model Autocorrelation Function (ACF) ,Autoregressive Models ,Moving Average Models ,ARMA and ARIMA Models , Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions	[6 Hrs]
Unit 4:	Data analytics and visualization with R: Introduction to R: Data Import and Export, Attribute and Data type, Descriptive statistics. Exploratory Data Analysis: Visualization before analysis, DirtyData, visualizing single variable, examining Multiple variable, Data Exploration versus presentation.	[6Hrs]
Unit 5:	Data analytics and Visualization with Python : Essential Data Libraries for data analytics:Pandas, NumPy, SciPy. Plotting and visualization with python: Introduction to Matplotlib, Basic Plotting with Matplotlib, Create Histogram, BarChart, Pie chart, Box Plot, violin plot using Matplotlib.	[7Hrs]

Text Books

1.	Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education services Wiley Publication
2.	Practical Statistics for Data Scientists 50+ Essential Concepts Using R and Python, O'Reilly Publications 2nd Edition

Reference Books

1.	Data Mining, Concepts and Techniques: 3rd edition, Jiawei Han, Micheline Kamber and Jian Pei
2.	Data Analytics using R, Bharati Motwani, Wiley Publications

Useful Links

1.	http://varianceexplained.org/RData/
2.	https://www.kaggle.com/code/iamleonie/time-series-interpreting-acf-and-pacf
3.	https://www.geeksforgeeks.org/data-visualization-using-matplotlib/

Program: B.Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5OE01	Open Elective: Business Intelligence & Analytics	3	1	0	4

Prerequisites for the course

1.	A core course on Business statistics desirable
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Prior Reading Material/useful links	
1.	Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Verzellis

COURSE OUTCOMES:

Sr. No	Course Outcome number	CO statement
1	CO1	Skills to execute Data-driven decision making through BI, through the use of specific charts and designing interactive dashboards and stories
2	CO2	Skills to execute Data cleaning/ETL and EDA activities for a BI project
3	CO3	Knowledge of core BI methodology and its strong relationship with data warehousing
4	CO4	Knowledge of current BI practices and trends in the global industry
5	CO5	Skill of data-driven decision making through interactive dashboards with hands-on activities on a BI tool of the instructor's choice

Syllabus:

Course Contents		Hours
Unit 1:	Introduction to Business Intelligence (BI): From DWH to BI: The Need for this Transition, BI Definition, Components of BI, Goals of BI, Types of BI, History of BI, The BI process/methodology: Steps to solve a business problem using BI, Industrial Applications and Industrial Surveys regarding BI (e.g., Gartner) , Evolution of BI tools: A brief history and Important features of these tools	[6 Hrs]
Unit 2:	Data Cleaning/ETL (Hands-on) : Reasons for dirty data and types of dirty data , Catering for missing values (e.g., MCAR, MAR, MNAR) , Detecting and correcting data entry errors , Other data cleaning activities preferred by instructor	[5 Hrs]
Unit 3:	Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models	[5 Hrs]
Unit 4:	Understanding the impact of BI Charts (hands-on) : Pie/Doughnut, Bar, Stacked Bar, Area, Line, Tables, Gauge, KPI scorecards, Maps, Scatter, Bubble, Heat map / Tree map, Waterfall, Funnel etc. , Other charts specific to selected tool, e.g., ribbon chart (PowerBI), NB: Hands-on with the above can be conducted over different datasets for better skill development	[7Hrs]
Unit 5:	BI Report and Dashboard Design Practices (hands-on): Best practices of interactive dashboard designs , Demonstration and practice of these design techniques, including drilldown on dashboards and creating and using hierarchies , NB: Hands-on with the above can be conducted over different datasets for better skill development, Forecasting feature in BI tools: technical details and importance (e.g., importance of sales forecasting) and practical demonstration	[7Hrs]

Text Books	
1.	Business Intelligence: A Managerial Approach by Efraim Turban, Ramesh Sharda, Dursun Delen, David King, 4th Edition, Pearson
2.	Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Verzellis, Wiley

Reference Books	
1.	Han, J., Pei, J. & Tong H. (2023). Data Mining Concepts and Techniques, 4th ed, New Delhi: Elsevier.
2.	Fundamental of Business Intelligence, Grossmann W, Rinderle-Ma, Springer, 2015

Useful Links	
https://www.cs.cmu.edu/~hn1/documents/entrepreneurshipdevelopment /notes.pdf	
https://news.vidyaacademy.ac.in/wp-content/uploads/2019/11/NotesOnEntrepreneurship Development-1.pdf	
https://github.com/dair-ai/ED-Course-Notes	

Program: B.Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5T004	Innovation and Entrepreneurship Development	2	0	0	Audit
Prerequisites for the course						
1	Basic Business Knowledge					
2	Communication and Networking Skills					
3.	Project Management Skills					

Prior Reading Material/useful links	
1.	https://www.cs.cmu.edu/~hn1/documents/entrepreneurshipdevelopment /notes.pdf
2.	https://news.vidyaacademy.ac.in/wp-content/uploads/2019/11/NotesOnEntrepreneurship Development-1.pdf
3.	https://github.com/dair-ai/ED-Course-Notes

COURSE OUTCOMES:

After learning the course the student will be able:

Sr. No	Course Outcome number	CO statement
1	CO1	Identify and validate of ideas
2	CO2	Remember Patent registration of Innovation.
3	CO3	Understand roles and responsibilities of Entrepreneurship.
4	CO4	Develop the skills to design, evaluate, and refine business models that effectively capture value for customers and generate sustainable revenue streams.
5	CO5	Gain proficiency in financial management principles and techniques, including budgeting, financial forecasting, and financial analysis.

Syllabus:

Course Contents		Hours
Unit 1:	Concept of creativity, innovation, invention, discovery. Methods for development of creativity, convergent & divergent thinking etc. Introduction to Intellectual Property Rights (IPR), Patent and laws related to patents.	[6 Hrs]
Unit 2:	Concept of entrepreneurship, its relations in economic developments, Eventuation of concept of entrepreneur, characteristics of an Entrepreneur, Types of entrepreneurs, Qualities of entrepreneur, Factors affecting growth of entrepreneurship.	[5 Hrs]
Unit 3:	Theory of achievement, motivation, Medelland's. experiment, Women entrepreneurship, Role of SSI, it's advantages & limitations, policies governing small scale industries, Procedure to set up small scale industrial unit, Advantages and limitations of SSI.	[5 Hrs]
Unit 4:	Factors governing project selection, Market survey, Preparation of project report. Financial, technical & market analysis of project. Entrepreneurial support systems, Role of consultancy organization like, District Industrial Centre, State Industrial Development Corporation, Financial institution, Latest SSI schemes of DIC (to be confirmed from DIC from time to time).	[7Hrs]
Unit 5:	Sources of funding for startups (e.g., bootstrapping, angel investors, venture capital), Financial management and budgeting, Pitching to investors and raising capital, Grants and government support programs	[4Hrs]

Text Books	
1.	Entrepreneurship Development, S. S. Khanka, S. Chand Publishers.

Reference Books	
1.	Creativity Innovation & Entrepreneurship, Zechariah James Blanchard, Needle Rat Business Publishers.

Useful Links
https://www.cs.cmu.edu/~hn1/documents/entrepreneurshipdevelopment /notes.pdf
https://news.vidyaacademy.ac.in/wp-content/uploads/2019/11/NotesOnEntrepreneurship Development-1.pdf
https://github.com/dair-ai/ED-Course-Notes

Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5L005	Data Mining Tools & Techniques LAB	0	0	2	1
Prerequisites for the course						
1	Knowledge of Database system, Data structure plus algorithms.					
2	Understanding of Arithmetic and Statistics, Business Principles.					

Prior Reading Material/useful links	
1.	Data Mining: Practical Tools and Techniques (The Morgan Kaufmann Series in Data Management Systems)

COURSE OUTCOMES: At the end of the Course the student shall be able to	
CO1.	Ability to add mining algorithms as a component to the existing tools
CO2.	Demonstrate the classification, clustering and etc. in large data sets.
CO3.	Construct algorithms to solve data mining problems using weka tool.
CO4	Demonstrate the classification and clusters Techniques in large datasets.
CO5	Ability to apply mining techniques for realistic data.

List of Experiments:

Course Contents	
1	Installation of WEKA Tool
2	Creating new Arff File
3	Pre-Processes Techniques on Data Set Pre-process a given dataset based on Handling Missing Values
4	Generate Association Rules using the Apriori Algorithm
5	Generating association rules using fp growth algorithm
6	Build a Decision Tree by using J48 algorithm
7	Naïve bayes classification on a given data set
8	Applying k-means clustering on a given data set
9	Calculating Information gains measures
10	OLAP Cube and its different operations
11	Case Study: Create Student. ariff file to suggest better college using Decision tree

12	Case Study: Create Placement.ariff file to identify the students who are eligible for placements using KNN
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Text Books	
1.	Andrew Moore's Data Mining Tutorial (On decision trees and cross validation).
2.	Data Mining algorithms by Rajan Chattamvelli, Narosa publishing house.

Reference Books	
1.	Data Preparation for Data Mining (The Morgan Kaufman Series) by Dorian pyle, First Edition.

Program: B.Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5L006	R programming for Data Science Lab	0	0	2	1
Prerequisites for the course						
1.	Basic understanding of R programming.					

Prior Reading Material/useful links	
1.	https://www.projectpro.io/article/python-projects-for-data-science/462
2.	https://www.youtube.com/watch?v=I10q6fjPxJ0
3.	https://data-flair.training/blogs/data-science-project-ideas/

Course Outcomes:

Course Outcome number	CO statement
CO1	Understand basic principles of R with data Science.
CO2	Implement object-oriented concepts and handling of data.
CO3	Implement data visualization method for effective visualization of data
CO4	Create user defined functions, strings, lists and perform searching & sorting.
CO5	Implement Oriented programming features of Python and process data sets.

Syllabus:

List of Experiments	
1.	Write R programs to understand Expressions, Variables, Quotes, Basic Math operations, Strings
2.	Perform Basic String Operations & String Methods, List etc.
3.	Write R programs to understand typecasting.
4.	R Program to Map Two Lists into a Dictionary
5.	Write R programs to understand different Object-oriented features in Python i.e. Inheritance & Polymorphism, Exception handling
6.	Write a R program to create a data frame for given data set.
7.	Write a R program to create the list, change the value of list, create list with different data types.
8.	R Program to Map Two Lists into a Dictionary
9.	Develop R program for Correlation coefficient.
10.	To draw basic plots in R program using Matplotlib.

Text Books	
1.	R Programming for Data Science, Roger D Peng, Lean Publication, 2016
2.	R for Data Science: Import, Tidy, Transform, Visualize, and Model Data by Hadley Wickham, O'RELLY, 2017

Reference Books	
1	Hands-On Programming with R: Write Your Own Functions and Simulations, Garrett Goleman, O'RELLY, 2014

Tech. in CSE (Data Science)

Semester	Course Code	Name of the course	L	T	P	Credits
V	DS5L007	WEB TECHNOLOGY LAB	0	0	2	1
	Prerequisites for the course					
1	Basics of HTML, CSS & JavaScript					
2	Database Fundamentals					
3.	Knowledge of Programming Concepts					

Prior Reading Material/useful links	
1.	https://www.cs.cmu.edu/~hn1/documents/web-technology/notes.pdf
2.	https://news.vidyaacademy.ac.in/wp-content/uploads/2021/20/NotesOnWebTechnologyForBTech-5.pdf
3.	https://github.com/dair-ai/WT-Course-Notes

COURSE OUTCOMES:

Course Outcome number	CO statement
CO1	Create well-structured HTML documents and apply CSS styles to design visually appealing and responsive web pages
CO2	Demonstrate proficiency in client-side scripting using JavaScript, including DOM manipulation, event handling, form validation, and asynchronous programming.
CO3	Develop server-side scripts using languages like PHP, Python, or Node.js to implement dynamic functionalities in web applications.
CO4	Integrate databases into web applications and perform CRUD (Create, Read, Update, Delete) operations using SQL or NoSQL databases.
CO5	Design web applications that adapt to different screen sizes and devices and ensure cross-browser compatibility for consistent user experience.

List of Experiments:

Course Contents	
1	Create a simple college webpage with headings, paragraphs, and lists.
2	Design a student registration form with different input types (text, radio buttons, checkboxes, dropdowns) & Embed images, videos, and hyperlinks into an HTML page.
3	Write a Program to Apply CSS styles to customize the appearance of HTML elements (colours, fonts, margins, padding). Also, implement CSS animations or transitions to add interactivity to elements.
4	Write a program to Design a responsive webpage that adapts its layout for various screen sizes using media queries & Test the responsiveness of the webpage on different devices and screen resolutions.
5	Write a program to Implement form validation using JavaScript to validate user input before submission.
6	Write a program to Dynamically add and remove HTML elements from the DOM using JavaScript &: Handle DOM events such as click, mouseover, and keypress using event listeners.
7	Write a program to Create RESTful API endpoints to perform CRUD operations on a database.
8	Write a program to Implement server-side validation and error handling for form submissions.
9	Write a program to Implement user authentication using Passport.js or a similar authentication middleware.

10	Write a program to create user registration and login forms with validation and error messages.
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Text Books	
1.	"HTML and CSS: Design and Build Websites" by Jon Duckett (1st Edition) McGraw-Hill Education, 1st Edition, 2011
2.	"JavaScript and jQuery: Interactive Front-End Web Development", Jon Duckett, 1st Edition, 2014.

Reference Books	
1.	"Web Technology: Theory and Practice" by B. Krishnamurthy, 1st Edition, 2016
2.	"Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML, and AJAX, Black Book" by Kogent Learning Solutions, 1st Edition, 2009
3.	"Web Technologies: HTML, CSS, JavaScript, PHP, MySQL, XML, JSP, ASP.NET, AJAX, Web 2.0, and SOA" by P. Sinha and P. K. Sinha, 1st Edition, 2008.

Useful Links	
https://www.cs.cmu.edu/~hn1/documents/web-technology/notes.pdf	
https://news.vidyaacademy.ac.in/wp-content/uploads/2021/20/NotesOnWebTechnologyForBTech-5.pdf	
https://github.com/dair-ai/WT-Course-Notes	

DS5P009

Mini Project

Credit 1

Evaluation Criteria: The total term work shall be of 50 marks. The 30 marks shall be distributed over internal assessments / reviews (at least 02 reviews) during the semester by a review committee. The remaining 5 marks shall be distributed for attendance. The Head of the Department shall constitute the review committee. The student shall make presentation on the progress made before the committee. The 20marks of the practical will be awarded based on

the performance in the practical exam conducted by the University at the end of the semester.

General Suggestions and Expectations / Guidelines

- The project shall be developed in C++/JAVA/PYTHON
- The students may choose the theory concepts they studied in different subjects as project topic.
- Interdisciplinary project proposals and innovative projects are encouraged and more appreciable.
- The project topic can be suggested by the staff member or it can be proposed by the students.
- The project topic shall be approved by the project in-charge.
- The Guides are advised to give projects and suggest project titles focusing more on the current field of research and ensure the level of innovation.
- A project team shall contain a maximum of 2 members.
- The project work should be properly distributed among the team members.
- Students should submit the project documentation at the beginning of the semester consisting of:

Title, Abstract Modules Split-up Deliverables for each review Data Model (If Any) Details of Team Members

- Reviews for the project work will be conducted at regular intervals by the panel of examiners formed by the Head of the Department.
- The student failing to attend the project review will be subject to strict action as decided by the Head of the Department.
- Throughout the semester at any point of time if students are found to be involved in any of

the following:

Using project codes available on the Internet

IT6P006 Mini Project Credit 1

Using project codes developed by someone else Using project work which is already submitted in other institute or university Such students shall be declared failed or penalized as decided by the Examiners.

- The students must arrange regular meetings with the guide and present progress of project work.
- A Spiral bound Project report to be prepared as per the guidelines and format given by the Department
- The guides are advised to check for the formatting of the presentation and project report.
- Students must submit a report well before the end of the semester.