Shri Vile Parle Kelavani Mandal's

# Dwarkadas J. Sanghvi College of Engineering

*(Autonomous College Affiliated to the University of Mumbai)*

Scheme and detailed syllabus

## Third Year B.Tech (DJ 19)

in

## Artificial Intelligence and Data Science

(Semester V)

# Syllabus for Third Year B.Tech Program in Artificial Intelligence & Data Science- Semester V (Autonomous)

Shri Vile Parle Kelavani Mandal's
**DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING**
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

**Proposed Scheme for Third Year Undergraduate Program in Artificial Intelligence and Machine Learning : Semester V (Autonomous)**
**(Academic Year 2023-2024)**

| Sr. No. | Course Code | Course | Teaching Scheme(hrs) | | | | Continuous Assessment (A) (marks) | | | | | Semester End Assessment (B) (marks) | | | | | Aggregate (A+B) | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Th | P | T | Credits | Term Test-1 | Term Test-2 | Term Test Avg. | T/W | Total CA (A) | Th | O | P | O &P | Total SEA (B) | | |
| 1 | DJ19ADC501 | Machine Learning | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | 4 |
| | DJ19ADL501 | Machine Learning Laboratory | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | 25 | -- | -- | 25 | 50 | |
| 2 | DJ19ADC502 | Advanced Algorithms | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | 4 |
| | DJ19ADL502 | Advanced Algorithms Laboratory | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | 25 | -- | -- | 25 | 50 | |
| 3 | DJ19ADC503 | Cloud Computing | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | 4 |
| | DJ19ADL503 | Cloud Computing Laboratory | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | 25 | -- | -- | 25 | 50 | |
| 4 | DJ19ADL504 | Data Engineering & Visualisation Lab | -- | 4 | -- | 2 | -- | -- | -- | 25 | 25 | -- | -- | -- | 25 | 25 | 50 | 2 |
| 5@ | DJ19ADC5011 | Devops | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | 4 |
| | DJ19ADL5011 | Devops Laboratory | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | -- | -- | 25 | 25 | 50 | |
| | DJ19ADC5012 | Spatial Data Analytics | 3 | | -- | 3 | 25 | 25 | 25 | | 25 | 75 | -- | -- | -- | 75 | 100 | |
| | DJ19ADL5012 | Spatial Data Analytics Laboratory | | 2 | -- | 1 | -- | -- | -- | 25 | 25 | | -- | -- | 25 | 25 | 50 | |
| | DJ19ADC5013 | Computer Graphics And Virtual Reality | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | |
| | DJ19ADL5013 | Computer Graphics And Virtual Reality Labora | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | -- | -- | 25 | 25 | 50 | |
| | DJ19ADC5014 | Web Programming | 3 | -- | -- | 3 | 25 | 25 | 25 | -- | 25 | 75 | -- | -- | -- | 75 | 100 | |
| | DJ19ADL5014 | Web Programming Lab | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | -- | -- | 25 | 25 | 50 | |
| 6 | DJ19A3 | Environmental Studies | 1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 7 | DJ19ILL1 | Innovative Product Development III (C) | -- | 2 | -- | 1 | -- | -- | -- | 25 | 25 | -- | -- | -- | -- | -- | 25 | 1 |
| | | **Total** | 22 | 20 | -- | 31 | 175 | 175 | 175 | 225 | 400 | 525 | 75 | 0 | 125 | 725 | 1125 | 19 |

| | | | |
|---|---|---|---|
| Th | Theory | T/W | Termwork |
| P | Practical | O | Oral |
| T | Tutorial | | |

**Prepared by** **Checked by** **Head of the Department** **Vice Principal** **Principal**

<table>
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</table>

**Prerequisite**: Knowledge of
Data Structures, Object oriented Python Programming Language, Foundation of Data Science

**Course Objectives:**

1. To get familiarize concepts of Machine Learning theoretically & practically

2. To explore the fundamentals field of Machine Learning through core concepts of supervised and unsupervised learning, Dimensionality reduction, clustering & SVM

**Outcomes: Students will be able to**

1. Classify given problems into classification, clustering and regression problems

2. Apply machine learning techniques for a given problem

3. Examine the dataset, choose appropriate algorithm and evaluate the results.

4. Design applications using machine learning algorithms

| **Detailed Syllabus: (Unit wise)** | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| 1 | **Introduction to Machine Learning:**<br>What is Machine Learning, Examples of Machine Learning Applications: Learning Association, Classification, regression, Unsupervised Learning , reinforcement learning<br>**Supervised Learning:** Learning class from examples, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm | **6** |
| **2** | **Bayesian Decision Tree:**<br>Introduction, Classification, Losses & Risks, Discriminant functions, Association rules<br>**Parametric Methods:** Introduction, Maximum Likelihood Estimation, Evaluating an Estimate, The Bayes Estimator, Parametric Classification, Regression, Turing model Complexity, Model selection procedure. | **8** |
| **3** | **Multivariate Methods:** Multivariate data, Parameter estimation, Estimation of missing values, Multivariate Normal distribution, Multivariate Classification, Tuning complexity, Discrete features, Multivariate regression**.** | **6** |
| **4** | **Dimensionality Reduction:** Introduction, subset selection, PCA, Feature Embedding, Factor analysis, Singular value Decomposition & Matrix Factorization, Multidimensional scaling, LDA,CCA, Isomap, LLE, Laplacian Eigen maps | **6** |
| **5** | **Clustering:** Introduction, Mixture Densities, K-means clustering, Expectation-Maximization Algorithm, Mixture of latent variable models, Types of Clustering<br>**Introduction to Support Vector Machine:** Support Vectors, Functional Margin, Geometric Margin, Optimization problem, Lagrange Duality, KKT condition, Maximum margin with noise, Non-linear SVM and Kernel Function | **8** |
| **6** | **Introduction to Artificial Neural Learning:** History of Deep Learning, Fundamental concepts of biological Neural Networks, Important terminologies of ANN: Activation functions: weights, bias, threshold, learning rate, momentum factor; McCulloch Pitts Neuron: Theory and Architecture; Linear separability; Hebb Network: Theory and Algorithm. | **5** |
| | **Total** | **39** |

**Books Recommended:**

***Text books:***

1. Ethem Alpaydin - Introduction to Machine Learning-The MIT Press (2014)
2. Tom M.Mitchell ―Machine Learning‖ McGraw Hill
3. Peter Harrington ―Machine Learning In Action‖, DreamTech Press
4. Ethem Alpaydın, ―Introduction to Machine Learning‖, MIT PressS.N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", 2nd Edition, 2011 Wiley India Pvt. Ltd

***Reference Books:***

1. Han Kamber, ―Data Mining Concepts and Techniques‖, Morgann Kaufmann Publishers
2. Stephen Marsland, ―Machine Learning An Algorithmic Perspective‖ CRC Press
3. Kevin P. Murphy , Machine Learning ― A Probabilistic Perspective‖
4. Andreas C. Müller and Sarah Guido- Introduction to Machine Learning with Python: A Guide for Data Scientists

**Suggested List of Experiments:**

| Sr. No. | Title of the Experiment |
|---|---|
| 1 | To implement CART decision tree algorithm |
| 2 | To implement Bayesian Classification. |
| 3 | To implement Naive Bayes algorithm |
| 4 | To implement Multivariate classification Algorithm |
| 5 | To implement Multivariate Linear regression |
| 6 | To implement PCA. |
| 7 | To implement K-Nearest Neighbour |
| 8 | To implement Support Vector Machine. |
| 9 | Mini project based on any machine learning application. |

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

*Laboratory:*

1. Oral examination will be based on the entire syllabus of course DJ19ADC501 including the practical performed during laboratory sessions of course DJ19ADL501.
2. Oral examination will be of **25 marks**.

**Continuous Assessment (B):**

**Theory:**

Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
Average of the marks scored in both the two tests will be considered for final grading.

**Laboratory: (Term work)**

Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 10 Marks
Miniproject:10 Marks
Journal Documentation (Write-up and solution of selected problem statement): 5 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

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</table>

**Prerequisite:**
Concepts of Data structures, Discrete mathematics, Analysis of Algorithm and Basics of Machine Learning

**Objectives:**

- To provide conceptual and practical knowledge of Advanced Data Structures and Analysis of Algorithms.

**Outcomes: On completion of the course, learner will be able:**

- Analyze the algorithm.
- Select appropriate data structure and algorithm for given problem statement.
- Apply best suitable algorithms for a specific task.
- Classify the algorithms based on the complexity.

| **Detailed Syllabus: (Unit wise)** | | |
|---|---|---|
| **Unit** | **Description** | **Hours** |
| **1** | **Analysis of Algorithm Based on Time**<br><br>Asymptotic notations: Omega, Theta, Big-O, Small-o, small Omega and Tilde<br>Beyond worst-case analysis<br>Amortized Analysis: Aggregate Method, Accounting Method, Potential Method (for Stack data structure)<br>Probabilistic and Randomized Algorithm: Probabilistic approach to algorithm and Randomized Analysis, Indicator Random Variable (IRV), Analysis of Hiring Problem | **5** |
| **2** | **Advanced Data Structures**<br>Balanced Search Trees: Red-Black Tree, Tango Tree, 2-3 Tree, B+ Tree, Splay Tree<br>Spatial Data Structure: KD Tree, R Tree<br>Probabilistic Data Structure: Bloom filter, LogLog and HyperLogLog, Count Min sketch<br>Functional Data Structures: Binomial Tree, Binomial Heap | **13** |
| **3** | **Algorithms for Data Science**<br>Dimension Reduction Algorithms: Rank-k approximation<br>Continuous Algorithms: Online gradient descent algorithm<br>Online Algorithms: Competitive Ratio, Ski Rental Problem, K-Server problem, List Accessing, Paging<br>Scalable algorithms: scalable algorithms for Centerpoints, Mining large graphs<br>graph algorithms for bioinformatics data analytics | **7** |
| **4** | **Graph Based Algorithms**<br>Flow Network Introduction: Residual Network, Augmenting Path, Ford-Fulkerson Method, Edmonds-Karp Method, Push-Relable Algorithm<br>Bipartite Matching: Maximum Bipartite Matching, Red-Blue Matching, Micali Vaziarni Algorithm | **6** |
| **5** | **Computational Algorithms**<br>Computational Geometry: Line Segment Properties, Convex Hull Graham's scan algorithm | **2** |
| **6** | **Classification of Algorithms**<br>Algorithm Classes: P, NP, NP Hardness and NP Completeness<br>Np Completeness Proofs: Satisfiability (3 sat), Reducibility, Cook's Theorem, Traveling Salesman Problem<br>Approximation Algorithms: Vertex Cover Problem, Travelling Salesman problem | **6** |
| | **Total** | **39** |

**Books Recommended:**

**Text books:**


- Introduction to Algorithms by Thomas H Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, Third Edition.
- Design and analysis of algorithms by S. Sridhar
- Horowitz, Sahani and Rajsekaran, ―Fundamentals of Computer Algorithms‖, Galgotia.
- Harsh Bhasin, Algorithms Design and Analysis, Oxford, 2015.
- Giuseppe Bonaccorso, Machine Learning Algorithms" by Packt

**Reference Books:**


- Rajeev Motwani, Prabhakar Raghavan, "Randomized Algorithm", Cambridge University
- S. K. Basu, Design Methods and Analysis of Algorithm, PHI
- Vijay V. Vajirani, Approximation Algorithms, Springer.
- Computational Complexity, Stanford University.
- Advanced Algorithms, CMU University
- Jason Brownlee, "Master Machine Learning Algorithms", by Machine Learning Mastery
- Network Data Analysis Printed Book


**Useful Links:**

- https://levelup.gitconnected.com/train-test-complexity-and-space-complexity-of-linear-regression-26b604dcdfa3
- https://7-hiddenlayers.com/time-complexities-of-ml-algorithms/
- https://towardsdatascience.com/importance-of-understanding-the-complexity-of-a-machine-learning-algorithm-9d0532685982
- https://www.thekerneltrip.com/machine/learning/computational-complexity-learning-algorithms/
- https://medium.com/ai-ml-at-symantec/ai-ml-security-pro-tips-understanding-minhash-in-a-security-context3dd0dd2ffe8#:~:text=MinHash%20is%20not%20typically%20thought,commonly%20used%20in%20machine%20learning.
- http://ccf.ee.ntu.edu.tw/~yen/courses/ds17/chapter-6d.pdf
- https://betterprogramming.pub/compressing-puppy-image-using-rank-k-approximation-a-doodle-explanation-c19de5dfd951
- https://parameterfree.com/2019/09/11/online-gradient-descent/

**Suggested List of Experiments:**

| Lab Session | Title |
|---|---|
| **1** | Experiment on Amortized Analysis |
| **2** | Experiment on Randomized Algorithms (Randomized Quick Sort) |
| **3** | Experiment on Advanced Data Structure (Red-black Tree Operations) |
| **4** | Experiment on Advanced Data Structure (B+ Tree Operations) |
| **5** | Experiment on Advanced Data Structure (MinHash Vector Representation) |
| **6** | Experiment on Machine Learning Algorithms (Ford Fulkerson Method) |
| **7** | Experiment on Machine Learning Algorithms (Ford Fulkerson Method) |
| **8** | Experiment on Graph Based Algorithms (Ford Fulkerson Method) |
| **9** | Experiment on Graph Based Algorithms (Push Relable Algorithm) |
| **10** | Experiment on Computational Geometry Algorithms (Graham Scan) |

| | |
|---|---|
| **11** | Experiment on Online Algorithms (K-Server algorithm) |
| **12** | Experiment on Approximation Algorithms (Vertex Cover) |
| **13** | Development of new algorithm by students based on any one topic of above mentioned syllabus |

Any other practical covering the syllabus topics and subtopics can be conducted.

**Evaluation Scheme:**
**Semester End Examination (A):**

**Theory:**
Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
Total duration allotted for writing the paper is 3 hrs.

**Laboratory:**
Oral examination will be based on the entire syllabus of course including the practical performed during laboratory sessions of course DJ19ADC502.
Oral examination will be of 25 marks.

**Continuous Assessment (B):**
**Theory:**
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.
Total duration allotted for writing each of the paper is 1 hr.
Average of the marks scored in both the two tests will be considered for final grading.

**Laboratory: (Term work)**
Laboratory work will be based on the experiments.
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</table>

**Prerequisite**: Knowledge of Computer Networks

**Course Objectives:**

1. To understand the concept of cloud computing.
   To make students familiar with various deployment models of cloud such as private, public,hybrid and community.
2. To make students familiar with various service models such as IaaS, SaaS, PaaS, Security asa Service (SECaaS) and Database as a Service.
3. Apply the different service models for the application.
4. To make students familiar with security and privacy issues in cloud computing and how to address them.

**Outcomes: Students will be able to**

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Analyze various cloud computing service models and implement them to solve the given problems.

3. Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.
4. Understand containerizing applications and services, testing them using **Docker**, and deploying them on a **Kubernetes** cluster
5. Understand the fundamental concepts of deploying and operating in the AWS Cloud
6. Design a cloud framework with appropriate resource management policies and mechanism.

| **Detailed Syllabus: (Unit wise)** | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| 1 | **Overview of Cloud Computing**<br>• Definition and essential characteristics<br>• A brief history and evolution of Cloud<br>• Key cloud service providers and their services<br>**Cloud Adoption and Emerging Technologies**<br>• Business case for Cloud Computing<br>• Emerging technologies supported by Cloud: AI, IoT, Blockchain, Analytics<br>**NIST and Cloud cube model** | 4 |
| **2** | **Cloud Computing Architecture -** Cloud computing stack Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models: Public cloud, Private cloud, Hybrid cloud. Data Center Architecture<br>**Cloud Resource Virtualization -** Introduction to virtualization Different approaches to virtualization Hypervisors Machine Image Virtual Machine (VM) Process VM vs System VM Resource Virtualization: Server, Storage, Network Full Virtualization vs Para Virtualization Operating System Support for Virtualization Virtual Machine (resource) Provisioning and Manageability VM Placement, VM Migration. | 6 |
| **3** | Cloud Deployment:<br>**Cloud Deployment Models**<br>Public, private, and hybrid cloud models, Advantages and use cases of each deployment model, Cloud service providers and their deployment model offerings, Factors influencing deployment model selection.<br>**Virtual Private Cloud (VPC)**<br>Introduction to VPC and its benefits, Networking concepts within a VPC (subnets, route tables, security groups) VPC peering and connectivity options, VPC design best practices and considerations, | 10 |

| | | |
|---|---|---|
| | **Elastic Compute Cloud (EC2) Service**<br>Overview of EC2 and its role in cloud computing, EC2 instance types and families, Provisioning and launching EC2 instances, configuring security groups and key pairs, Managing EC2 instances (start, stop, terminate), Elastic IP addresses and Elastic Network Interfaces (ENIs) | |
| **4** | **Hybrid Cloud Technologies: Dockers, Containers And Kubernetes, Openshift**<br>Introduction to containers, Introduction to Docker, Building container images, Using container registries, Running containers, Understanding container orchestration, Understanding Kubernetes architecture, Introduction to Kubernetes objects, Using basic Kubernetes objects<br>Using the kubectl command, Leveraging Kubernetes, Using ReplicaSets, Using autoscaling Understanding rolling updates Understanding ConfigMaps and secrets Using service bindings<br>The Kubernetes Ecosystem | 10 |
| **5** | **Cloud Databases And Data Security**<br>Storage Service: Introducing S3, working with Buckets, setting bucket security, S3 event and notification, bucket properties, working with Elastic Block Store Volumes, Object Storage Vs Block Storage, Archives versus backups, .<br>Database and analytics : Introduction to Amazon Relational Database Service (RDS), Database Engines, Database Instance Classes, Backup and Recovery, Non-relational (No-SQL) Databases, Types of Non relational Databases, Introduction to DynamoDB, Features, Partition and Hash Keys. | 9 |
| | **Total** | **39** |

**Books Recommended:**

*Text books:*

1. Bernard Golden, “Amazon Web Services for Dummies”, John Wiley & Sons, Inc.
2. Michael Collier, Robin Shahan, “Fundamentals of Azure, Microsoft Azure Essentials”, Microsoft Press.
3. RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, “Mastering Cloud Computing”, Tata McGraw-Hill Education.
4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley publishing.
5. John Paul Mueller, “AWS for Admins for Developers”, John Wiley & Sons, Inc.
6. Ken Cochrane, Jeeva S. Chelladhurai, NeependraKhare , “Docker Cookbook - Second Edition”, Packt publication
7. Jonathan Baier, “Getting Started with Kubernetes-Second Edition”, Packt Publication

***Reference Books:***

1. Marinescu, Dan C. Cloud Computing: Theory and Practice. Morgan Kaufmann, 2017.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Mc Graw Hill Education, 1st Edition, 2017.
3. Buyya, Rajkumar, Christian Vecchiola, and S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Applications Programming, Tata Mcgraw Hill, 1st Edition, 2017.

**Suggested List of Experiments**: (Any 8 Experiments can be considered for implementation)

| | |
|---|---|
| **1** | **Configure a VM instance in your local machine and in cloud (by creating a** cloud account). Allocate CPU, memory and storage space as per a specified requirement. Install Guest OS image in that instance, launch the same and confirm the successful installation of the OS by performing few OS commands. |
| **2** | To study and implement Hosted Virtualization using Virtual Box & KVM |
| **3** | To study and Implement Infrastructure as a Service using AWS/Microsoft Azure/Google cloud platform |
| **4** | To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/MongoDB Lab/ Firebase. Lab9: To study and Implement Containerization using Docker on AWS/Azure/Google cloud platform |
| **5** | To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service |
| **6** | To study and Implement Containerization using Docker |
| **7** | To study and implement container orchestration using Kubernetes on AWS/Azure/Google cloud platform |
| **8** | Experiment cloud load balancing algorithms using Cloud Sim/ OPNET/ CloudAnalyst tool. |
| **9** | Monitor, visualize and analyze performance of resource utilization in cloud platforms using Grafana tool. |
| **10** | Build container images, launch the container instance in the cloud and run an application inside the container instance in cloud |
| 11 | Design a Web Application hosted on public cloud platform |

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
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<tr><td colspan="6">Program: Third Year B.Tech. in Artificial Intelligence & Data Science</td><td colspan="5">Semester : V</td></tr>
<tr><td colspan="6">Course : Data Engineering & Visualisation Lab</td><td colspan="5">Course Code: DJ19ADL504</td></tr>
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<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

**Pre-requisite:** Databases, Python

Course Objectives:

1. To define big data solutions for business intelligence & analyses business case studies for big data analytics.
2. To develop map-reduce analytics using Hadoop and data storage and management using NoSql.
3. To perform real-time analysis on streaming data.
4. To develop a comprehensive understanding of data visualization principles and techniques using Tableau and Power BI.
5. To acquire hands-on experience in creating interactive and effective visualizations for various data sets.

**Outcomes:** Students will be able to

1. Describe big data and use cases from selected business domains.
2. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics
3. Build and maintain reliable, scalable, distributed systems using Apache Spark.
4. Design and build MongoDB based Big Data Applications and learn MongoDB query language.
5. Students will be able to demonstrate proficiency in using Tableau and Power BI to create visually compelling and interactive data visualizations on complex data sets
6. Students will be able to communicate data-driven insights and stories through visually engaging presentations using Tableau and Power BI.

| Detailed Syllabus: (Unit wise) | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| **1** | **Introduction to Big Data and Hadoop**<br>● Introduction to Big Data, Big Data characteristics, Drivers, types of Big Data,<br>● Case Study of Big Data Solutions , Bigdata Applications<br>● Societal and Ethical issues associated with the use of big data analytics<br>● Big Data – Apache Hadoop & Hadoop EcoSystem<br>● Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce Concept of Hadoop<br>● HDFS Commands, MApReduce-The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution | 08 |
| **2** | **HDFS, HIVE AND HIVEQL, HBASE**<br>● HDFS-Overview, Installation and Shell, Java API;<br>● Hive Architecture and Installation, Comparison with Traditional Database, HiveQL Querying Data, Sorting And Aggregating,<br>● HBase concepts, Advanced Usage, Schema Design, Advance Indexing, PIG- Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts<br>● Zookeeper , how it helps in monitoring a cluster | 08 |
| **3** | **NoSQL**<br>● **Relational vs NoSQL Data Sore**<br>Types of NoSQL Stores: Document based, Key-value based, Column Based, Graph based. | 10 |
| **4** | **SPARK :** Introduction to Data Analysis with Spark, Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib.<br>**Processing of Real Time Data and Streaming Data:** Data Streams: Introduction and Ingestion, Kafka, Storm & Storm Assignment, Spark Streaming | 10 |
| **5** | **Introduction to Data Visualization and Tools:**<br>● Understanding the fundamentals of data visualization<br>● Introduction to Tableau and Power BI<br>● Exploring the user interface and features of Tableau and Power BI<br>● Data cleaning and transformation for visualization<br>● Choosing appropriate chart types for different data scenarios<br>● Creating interactive visualizations using Tableau and Power BI | **8** |

| | | |
|---|---|---|
| **6** | **Advanced Visualization and Dashboard Design:**<br>• Advanced chart types and visualization techniques<br>• Designing effective dashboards for data exploration and presentation<br>• Applying best practices for visual storytelling in Tableau and Power BI | **8** |
| | **Total** | **52** |

**Books**

**Recommended:**

**Text Books**

1. Understanding Big data - Chris Eaton,Dirk derooset al. McGraw Hill
2. MongoDB in Action - Kyle Banker,Piter Bakkum, Shaun Verch, Dream tech Press
3. Beginning Apache Pig-Big Data Processing Made Easy-Balaswamy Vaddeman, Apress'
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
5. Eric Sammer, "Hadoop Operations", Reilly, 2012.

**Reference Books**

1. Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Understanding *Big Data: Analytics for Enterprise Class Hadoop and streaming Data*,The McGraw-Hill Companies, 2012.
2. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
3. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
4. Alan Gates, "Programming Pig", O'Reilley, 2011

**Online Recourses:**

1. Tableau Tutorial for Beginners in 20 Minutes | Complete Tableau Training for Beginners | Simplilearn - YouTube
2. Power BI Full Course | Power BI Tutorial For Beginners | Power BI Course | Simplilearn - YouTube
3. Power BI Tutorial (tutorialspoint.com)
4. Tableau Tutorial (tutorialspoint.com)

**Suggested List of Experiments:**

| Sr. No. | Title of the Experiment |
|---|---|
| 1. | Installation of Hadoop on a single node cluster |
| 2. | Execution OF HDFS Commands. |
| 3. | Execution of MapReduce program for sorting of numbers and counting word occurrences in a text file. |

| | |
|---|---|
| 4. | Execute HIVE commands to load, insert, retrieve, update, or delete data in the tables. |
| 5. | Execute PIG built in commands and rum pig scripts on HDFS |
| 6. | Installation and Configuration of Apache Spark. Execution of ML algorithms using Apache Spark Mlib |
| 7. | Perform CRUD Operations using a Graph based Data Store |
| 8. | Perform CRUD Operations using a Document based Data Store |
| 9. | Read streaming data using Kafka. |
| 10. | Perform Twitter Sentiment analysis using Spark Streaming |
| 11 | Creating an interactive drill-down dashboard to explore sales data by product categories using Tableau. Also visualize using sctterplot, stacked area chart, barchart, waterfall chart Etc. |
| 12 | Depict time-series data trends in Power BI and visualize using various charts. |
| 13 | Creating a geographic map visualization to display regional sales using Power BI. |
| 14 | Designing a heat map,treemap to visualize customer engagement patterns in Power BI. |
| 15 | Designing an interactive dashboard with filters and parameters to visualize survey responses using Power BI. |
| 16 | Miniproject |

**Evaluation Scheme:**

***Laboratory:***

1. Oral and practical examination will be based on the entire syllabus of practical performed during laboratory sessions of course DJ19ADL504.
2. Oral and practical examination will be of **25 marks**.

**Continuous Assessment (B):**

**Laboratory: (Term work)**
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 10 Marks
Miniproject:10 Marks
Journal Documentation (Write-up and solution of selected problem statement): 5 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="8">Program: Third Year B.Tech. in Artificial Intelligence & Data Science</td><td colspan="3">Semester : V</td></tr>
<tr><td colspan="8">Course : Devops</td><td colspan="3">Course Code: DJ19ADC5011</td></tr>
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</table>

**Pre-requisite: Python, Operating Systems**

**Objectives:**

1. The objective of this course is to familiarize learners with different development frameworks.
2. To introduce the principles and processes of software engineering and Devops.

**Outcomes:** On completion of the course, the learner will be able to:

1. Apply software engineering principles for application development.
2. Students will be to interpret and apply various principles, phases and activities of Agile as well as scrum methodology
3. Be able to understand and implement Devops principles for CI/CD
4. Apply testing process for application development.
5. Students will be able to apply Configuration Management Tools using Containerization

| Devops (DJ19ADC5011) | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| **1** | **Introduction:** Fundamentals of Software Engineering- process framework, Software Development Life Cycle (SDLC) Process Models: Incremental and Evolutionary.<br><br>**Devops:** Introduction to Devops, definition, History of Devops, Objectives, Continuous Integration & Deployment, Containers and Virtual Development, Configuration Management Tools. | 07 |
| **2** | **Fundamentals of Agile Process:** Need of Agile software development, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development, Business benefits of software agility. | 07 |
| **3** | **Source Code Management:** Version Control: GIT Features, 3-Tree Architecture, GIT – Clone /Commit / Push, GIT Hub Projects, GIT Hub Management, GIT Rebase & Merge, GIT Stash, Reset, Checkout, GIT Clone, Fetch, Pull, Membership GITHUB. | 06 |
| **4** | **Continuous Integration:** Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices, Continuous integration, tools, Build & Test Applications with Continuous Integration, Scheduling build Jobs, Build Scripts, Build Pipeline, Master & Slave Node Configuration, Workspace Management, Security and plugins, Other integration tools | 06 |
| **5** | **Continuous Testing:** Introduction to Selenium, Installing Selenium, Creating Test Cases in Selenium WebDriver, Run Selenium Tests in Jenkins Using Maven, Functionality Testing, UI Testing, Performance Testing, Security Testing. | 05 |
| **6** | **Configuration Management in Devops:** The Process of Configuration, Configuration Management in DevOps.<br>**Configuration Management Tools Containerization:** Docker introduction, Docker Image, working with Docker Containers, Docker Engine, Creating Containers with an Image, Working with Images, Docker Hub, Docker Trusted Registry, Docker File & Commands.<br>**Devops Monitoring Tool:** Introduction to Nagios, Architecture. | 08 |
| | **Total** | **39** |

**Suggested List of experiments:**

| Devops Laboratory (DJ19ADL5011) | |
|---|---|
| **Exp.** | **Suggested experiments** |
| **1** | Write code for a simple user registration form for an event.<br>To Study DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities. |
| **2** | To carry out Version Control System / Source Code Management, install git and create a GitHub account. |
| **3** | To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet. |

| | |
|---|---|
| **4** | Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job. |
| **5** | To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server. |
| **6** | To Setup and Run Selenium Tests in Jenkins Using Maven. |
| **7** | To study Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers. |
| **8** | To study Dockerfile instructions, build an image for a sample web application using Dockerfile. |
| **9** | To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet. |
| **10** | To perform Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function). |

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

**Books Recommended:**

***Text books:***

1. Software Engineering: A Practitioner's Approach, Eight Edition by Roger S. Pressman and Bruce R. Maxim, McGraw-Hill Education, 2019.
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication, 2nd edition, 2018.
3. Len Bass, Ingo Weber, Liming Zhu,"DevOps, A Software Architects Perspective", Addison Wesley Pearson Publication, Ist edition, 2015.
4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication 1st 2011.
5. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, by Ryan Russell Yates Packt Publishing (September 29, 2018)

***Reference Books:***

1. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive By Sricharan Vadapalli, Packt, 2018.
2. Agile Testing: A Practical Guide For Testers And Agile Teams, Lisa Crispin, Janet Gregory, Pearson, 2010.
3. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin, Addison Wesley, 2015.
4. DevOps: Puppet, Docker, and Kubernetes By Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, Packt, 2017
5. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith, Addison-Wesley Professional, 2009
6. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly.

***Online References:***

1. www.javatpoint.com, https://www.javatpoint.com/devops
2. www.guru99.com, https://www.guru99.com/devops-tutorial.html

3. www.tutorialspoint.com, https://www.tutorialspoint.com/devops_tutorials.htm
4. www.simplilearn.com, https://www.simplilearn.com/tutorials/devops-tutorial
5. www.edureka.co, https://www.edureka.co/blog/devops-tutorial
6. https://www.jenkins.io, https://www.jenkins.io/doc/tutorials/
7. https://github.com, https://github.com/learn/devops
8. www.dotnettricks.com, https://www.dotnettricks.com/learn/devops

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

*Laboratory:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC5011 including the practical performed during laboratory sessions of course DJ19ADL5011.
2. Oral and practical examination will be of **25 marks**.

***Continuous Assessment (B):***

**Theory:**
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

**Laboratory: (Term work)**
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
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<tr><td colspan="5">Course: Spatial Data Analytics Laboratory</td><td colspan="6">Course Code: DJ19ADL5012</td></tr>
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</table>

**Pre-requisite: Python, Database Management Systems**

**Course Objectives:**

1. Understand the fundamental concepts and theories of spatial data analytics.
2. Acquire practical skills in handling and manipulating spatial datasets.
3. Apply spatial analysis techniques to uncover patterns and relationships in spatial data.
4. Develop proficiency in using GIS software and programming languages for spatial data analysis.
5. Evaluate and interpret the results of spatial data analysis using statistical methods.

**Course Outcomes: By the end of this course, students will be able to:**

1. Demonstrate a solid understanding of the principles and theories of underlying spatial data analytics.
2. Apply various techniques to pre-process, clean, and manage spatial datasets.
3. Perform spatial analysis operations such as spatial queries and spatial indexing
4. Utilize GIS software and programming languages to conduct spatial data analysis.
5. Interpret and communicate the results of spatial data analysis effectively and apply spatial data analytics to address real-world problems and scenarios.

| Detailed Syllabus (Unit wise) | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| 1 | **Module 1: Introduction to Spatial Informatics**<br>Introduction to Spatial Informatics, Spatial Database, Spatial Data-Types, Spatial Data Structure, Spatial Object Types, Operations, Topological relationships, Spatial Data Models: Logical Data Model, Scenario based Case Study, Integration of Data Models. | **5** |
| **2** | **Module 2: Spatial Query Processing & Retreival**<br>Spatial Query Processing: Interoperability-Challenges, Open Geospatial Consortium(OGC) Standards, Geographic Markup Language(GML), Conceptual Frameworks for Spatial Analysis, Basic Primitives, Spatial Relationships, Spatial Statistics, Spatial Data Infrastructure | **8** |
| **3** | **Module 3: Spatial Data Management**<br>SQL with Open Geospatial Standard, Queries, Views, Query Processing, Optimisation, query Trees, Spatial Database Vs Relational Database<br>Spatial Data Indexing, Approaches, Operations, One dimensional Embedding, File Structures: Hash, Clustering-Z curve, Hilbert Curve, Quadtrees, Spatial Objects with R-Tree, Search in R-trees | **8** |
| **4** | **Module 4: Spatial Networks**<br>Introduction, Case Study on Navigation Systems, Spatial Network Data Models, Operations, Transitive Closure, SQL3 Recursion, Algorithms, Shortest path, hierarchical routing Algorithms, Graph based Storage methods | **6** |
| **5** | **Module 5: Spatial Computing and Spatial Analysis**<br>Spatial Data Mining, Approaches, Case Study on Hotspots, Location Prediction, Spatial Patterns, Spatial Auto Correlation, Types, Statistical test | **6** |
| **6** | **Module 6: Geo-visualization, Spatial Cloud**<br>Spatial Data Science-Challenges.<br>Case study on Spatio-temporal Prediction of Time-Series Data, Movement Analysis on GPS Footprints, Bigdata for Spatial Analytics, Geospatial Cloud Architecture, Geo Visualisation Tools | **6** |
| | **Total** | **39** |

**List of Experiments: (**Perform any 8 Experiments**)**

| Sr. No. | Experiment Title |
|---|---|
| **1** | Importing and exploring spatial datasets using GIS software. |
| **2** | Performing spatial queries and attribute joins. |
| **3** | Visualizing spatial patterns through choropleth maps and heatmaps. |
| **4** | Conducting point pattern analysis to identify clustering. |
| **5** | Implementing spatial interpolation techniques for spatial prediction. |
| **6** | Developing a spatial regression model for a given dataset. |

| | |
|---|---|
| **7** | Analyzing spatial autocorrelation using Moran's I statistic. |
| **8** | Conducting geostatistical analysis and kriging interpolation. |
| **9** | Applying spatial data mining techniques to identify spatial associations. |
| **10** | Working on a real-world project involving spatial data analysis and visualization |
| **11** | Customize maps to and perform layer styling. |
| **12** | Usecase on Geo-Spatial Cloud |

**Books:**

1. Python for Geospatial Data Analysis, Bonny P. McClain, O'Reilly Media, Inc. October 2022
2. Philippe Rigaux, Michel Scholl, Agnes Voisard, "Spatial Databases with Applications to GIS", Morgan Kaufmann, 2002
3. Principles of geographical information systems, by P. A. Burrough, Oxford Press

**References:**

1. "Spatial Data Analysis: An Introduction for GIS Users" by Christopher D. Lloyd.
2. "The GIS Guide to Public Domain Data" by Joseph J. Kerski.
3. Spatial Databases: A Tour, by Shashi Shekhar, Sanjay Chawla, Prentice Hall,2003
4. Open Geospatial Consortium (OGC): http://www.opengeospatial.org/
5. ACM Transactions on Spatial Algorithms and Systems
6. https://spatialanalysisonline.com/HTML/index.html

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

*Laboratory:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC5012. including the practical performed during laboratory sessions of course DJ19ADL5012.
2. Oral and practical examination will be of **25 marks**.

***Continuous Assessment (B):***

**Theory:**
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

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<tr><td colspan="8">Course : Computer Graphics Virtual Reality</td><td colspan="3">Course Code: DJ19ADC5013</td></tr>
<tr><td colspan="8">Course: Computer Graphics Virtual Reality Laboratory</td><td colspan="3">Course Code: DJ19ADL5013</td></tr>
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**Prerequisite:** Basic Mathematics, C Programming, Java

**Course Objectives:**

- The course intends to introduce the students to fundamental knowledge and basic technical competence in the field of computer graphics and virtual reality.
- The course will acquaint the student with algorithms for generating and rendering graphical models, mathematics for geometrical transformations and techniques of projections.
- The course will also introduce the students to fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

**Course outcomes:** On successful completion of this course, learner will be able to:

1. Implement various algorithms to generate lines, circles, curves, fractals, polygons and color them.
2. Apply 2D and 3D Transformations, viewing and projections on a given object.
3. Design an animation sequence.
4. Design a Virtual Reality application.

| Detailed Syllabus: (unit wise) | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| **1** | **Introduction to Computer graphics and Output Primitives:** Graphics primitives- pixel, resolution, aspect ratio, frame buffer, refresh rates, Display Devices, Bitmap and Vector based graphics, Overview of Coordinate system.<br>Scan Conversion of - point, line using Digital differential analyser & Bresenham's algorithm, circle using midpoint approach and Bresenham.<br>**Polygons:** Concave, Convex, Inside/Outside Test<br>**Area Filling:** Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fill algorithm<br>**Curves:** Introduction to curves, interpolation and approximation, Blending Function, Bezier and B-spline curves<br>**Fractals:** Introduction, Classification, Fractal Generation- Snowflake, Sierpinski Gasket, Koch Curve, Cantor Middle-Thirds Set, Hilbert Curve, Applications of Fractals. | 10 |
| **2** | **Two Dimensional Transformations:** Basic Geometrical 2D transformations- Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation, and Composite transformation.<br>**Three Dimensional Transformations:** Translation, Rotation, Scaling, Rotation about an arbitrary axis | 08 |
| **3** | **Viewing Transformations and Projections:** Introduction, Viewing Pipeline, View Coordinate reference frame, Window to Viewport Transformation, Point Clipping, Line clipping: Cohen Sutherland Algorithm, Liang Barsky Algorithms, Polygon Clipping: Sutherland Hodgeman Polygon Clipping and Weiler Atherton, Text Clipping.<br>Three-Dimensional Viewing Pipeline, Viewing Transformation, Projections: Parallel (Oblique and Orthographic), Perspective (one Point, two point and three point) | 06 |
| **4** | **Introduction to Animation:** Key Frame Animation, Animation Sequence, Motion Control Methods, Morphing, Warping (only Mesh Warping). | 03 |
| **5** | **Introduction to Virtual Reality:** Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception., Three I's of virtual reality and Classic Components of VR systems, Applications of VR systems.<br>Input – 3D position Trackers and its types, Navigation and Manipulation Interfaces, Gesture Interfaces, Graphics Displays – HMD and CAVE, Sound Displays, Haptic Feedback<br>Graphical Rendering Pipeline, Haptics Rendering Pipeline. | 05 |
| **6** | **VR Modeling & Programming:** Geometric Modeling: Virtual Object Shape, Object Visual Appearance. Kinematics Modeling: Object Position, Transformation Invariants, Object Hierarchies, Physical Modeling: Collision Detection, Surface Deformation, Force Computation. Behavior Modeling<br>Programming through VRML/X3D: Defining and Using Nodes and Shapes, VRML Browsers, Java 3D, OpenCV for augmented reality. | 07 |
| | **Total** | **39** |

**List of Laboratory Experiments:**

| Sr. No. | Experiment Title |
|---|---|
| 1 | Implementation of Line Drawing algorithms: DDA, Bresenham and using them generate line with different styles like dotted, dashed, centered and thick line. |
| 2 | Implementation of Circle generation algorithms and using it generate concentric circles. |
| 3 | Implementation of Area Filling Algorithm: Boundary Fill, Flood Fill and Scan line, Polygon Fill. |
| 4 | Generate a Bezier curve for n control points. |
| 5 | Program for performing two dimensional transformations |
| 6 | Implement Line clipping algorithms. |
| 7 | Implementation of Polygon Clipping Algorithm |
| 8 | Generate a snowflake using fractals. |
| 9 | Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same. |
| 10 | Develop a scene in Unity that includes:<br>a. A cube, plane and sphere, apply transformations on the 3 game objects.<br>**b.** Add a video and audio source. |
| 11 | Create a 3D animation using VRML |

**Books Recommended:**

***Text books:***

1. Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", 2nd Edition, Pearson Education
2. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication
3. Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.
4. Rajesh K. Maurya, "Computer Graphics with Virtual Reality", Wiley India Publication.
5. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", second edition, Wiley India Edition, ISBN 81-265-0789-6

***Reference Books:***

1. Donald Hearn and M. Pauline Baker, "Computer Graphics with Open GL", 4th Edition, Pearson Education
2. Steven Harrington, "Computer Graphics", McGraw Hill.
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill.
4. F.S. Hill, Stephen M. Kelley, "Computer Graphics using Open GL" Prentice Hall

5. Samit Bhattacharya, "Computer Graphics", Oxford Publication
6. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann Publishers, San Francisco, CA, 2002

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

*Laboratory:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC5013. including the practical performed during laboratory sessions of course DJ19ADL5013.
2. Oral and practical examination will be of **25 marks**.

***Continuous Assessment (B):***

**Theory:**
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

**Laboratory: (Term work)**
Laboratory work will be based on the experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of Experiments): 15 Marks
Journal Documentation (Write-up and solution of selected problem statement): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Head of the Department Principal

<table>
<tr><td colspan="5">Program: Third Year B.Tech. in Artificial Intelligence & Data Science</td><td colspan="5">Semester : V</td></tr>
<tr><td colspan="5">Course : Web Programming</td><td colspan="5">Course Code: DJ19ADC5014</td></tr>
<tr><td colspan="5">Course: Web Programming Laboratory</td><td colspan="5">Course Code: DJ19ADL5014</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme<br>(Hours / week)</td><td colspan="10">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td>Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td><td></td></tr>
<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">50</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">2</td><td rowspan="2">--</td><td rowspan="2">4</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td></td><td>--</td><td>25</td><td>15</td><td colspan="2">10</td><td>25</td></tr>
</table>

**Prerequisite**: -

**Course Objectives:**

1. To get familiar with the basics of Web fundamentals
2. To acquire knowledge and skills for creation of web site considering both client and server-side programming.
3. To gain ability to develop responsive web applications.
4. To understand REST API and MongoDB for Frontend and Backend Connectivity.

**Outcomes: Students will be able to**

1. Implement interactive web page(s) using HTML5, CSS3 and Bootstrap.
2. Apply JavaScript to add functionality to web pages.
3. Design Web Applications using Typescript.
4. Construct front end applications using React
5. Construct back end applications using Node.js/Express
6. Create REST Web services using MongoDB

| **Internet Programming (DJ23ADC5014)** | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| 1 | **HTML5, CSS, and Bootstrap**<br>Introduction to HTML, HTML Basics, HTML Elements, HTML5 Semantic, Attributes, Headings, Paragraph, styles, Hyperlink, Formatting, Images, Tables, List, Frames, Forms, Multimedia, Canvas API, SVG API, HTML5 Media (Video & Audio), Web Storage (DOM) API, Geolocation<br>**CSS**<br>Syntax, Inclusion, Color, Background, Fonts, Tables, Typography lists, CSS3 selectors, Pseudo classes, Pseudo elements Tailwind CSS, CSS3-Multi Column Layout, Media Queries<br>**Bootstarp:** Grid system, Forms, Button, Navbar, Breadcrumb, Jumbotron, Introduction to Apache Tomcat Server | 7 |
| **2** | **Java Script**<br>Introduction to JavaScript Language: Overview and Syntax JavaScript: Variables and Control Statements JavaScript: Functions and Prototypes JavaScript APIs Client-Side JavaScript: with HTML Client-Side JavaScript: with DOM JavaScript DOM Objects , Java script Regular expression, Event Handling, DHTML with JavaScript, JSON Introduction, Syntax, Function Files, Http Request, SQL, Introduction to jQuery jQuery Syntax jQuery Selectors jQuery Events jQuery Effects jQuery HTML jQuery Traversing jQuery AJAX & Misc | 4 |
| **3** | **TypeScript**<br>Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules<br>**Angular**<br>Introduction to Angular, Angular Application Architecture, what is Ng Module?, Angular Components, Angular Templates, Data Binding, Types of Data Binding Modules Component Working, Directives, Structure Directives, Template Routing, Theme Implementation in Angular Framework, Angular Forms, Services, Inject Services, Angular Server Communication with Backend Server, Working of API's (GET, POST, PUT, DELETE), Complete Web application in Angular Framework | 10 |
| **4** | **React.js and advanced react.js**<br>**React JS:**<br>Installation, Installing libraries, Folder and file structure, Components, Component lifecycle, State and Props, React Router and Single page applications, UI design, Forms, Events, Animations, Best practices.<br>**Advanced React.js:**<br>Functional components- Refs, Use effects, Hooks (useState, useEffect, useContext, etc.), Flow architecture, Model-View-Controller framework, | 5 |

| | | |
|---|---|---|
| | Flux, Bundling the application. Web pack, Redux for state management, Routing with React Router React.js and other libraries: Using third-party libraries with React.js (such as Material-UI or Bootstrap), Deploying a React.js app to a web server, Integration with CI/CD pipelines | |
| **5** | **Node.js, Express.js:**<br>**Node.js:** Introduction to Node.js, Javascript and Nod.js,import and Require Introduction to Server-Side JavaScript, Creating a Web Server with Node.js, Working with Node.js Modules,<br>**Advanced Node.js** Overview of NPM, Local and Global Package Install, Asynchronous programming, Callback concept, Event loops, REPL, Event emitter, Networking module, Buffers, Streams, File system, Web module.<br>**Express Nodes.js:** Itroduction, Express router, REST API, Generator, Authentication, sessions, Integrating with React. | 7 |
| **6** | **Database Handling:**<br>Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. REST API: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (create, read, update, delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints | 6 |
| | **Total** | **39** |

**Books Recommended:**

***Text books:***

1. John Dean, “Web Programming with HTML5, CSS3 and JavaScript”, Jones & Bartlett Learning, 2019 Edition.
2. Rediscovering JavaScript, Master ES6, ES7, and ES8, By Venkat Subramaniam · 2018
3. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O’Reilly.
4. Learning Redux, Daniel Bugl, Packt Publication.
5. Learning Node.js Development, Andrew Mead, Packt Publishing
6. RESTful Web API Design with Node.js 10, Valentin Bojinov, Packt Publication
7. Boris Cherny, “Programming TypeScript- Making Your Javascript Application Scale”, O’Reilly Media Inc., 2019 Edition.
8. Adam Bretz and Colin J. Ihrig, “Full Stack JavaScript Development with MEAN”, SitePoint Pty. Ltd., 2015 Edition.
9. Simon Holmes Clive Harber, “Getting MEAN with Mongo, Express, Angular, and Node”, Manning Publications, 2019 Edition.

***Reference Books:***

1. Web Development with Node and Express, Ethan Brown, O'Reilly
2. Glenn Johnson, "Programming in HTML5 with JavaScript and CSS3", Microsoft Press, 2013 Edition.
3. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications, 2020 Edition.
4. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress, 2014 Edition.
5. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, AddisonWesley Professional, 2018 Edition

**Online Resources:**

1. https://www.udemy.com/course/crash-course-html-and-css/
2. https://nptel.ac.in/courses/106106156
3. https://www.udemy.com/course/reactjs-training/
4. https://reactjs.org/tutorial/tutorial.html
5. https://react-redux.js.org/introduction/quick-start
6. https://www.udemy.com/course/mern-stack-course-mongodb-express-react-and-nodejs/
7. https://www.classcentral.com/course/skillshare-create-a-web-app-with-react-mongodb-express-andnodejs-84146
8. https://webpack.js.org/
9. https://www.youtube.com/watch?v=-27HAh8c0YU

**Suggested List of Experiments**:

| | |
|---|---|
| 1 | Using HTML5 layout tags develop informative page with sections which include various images, links to other pages for navigation, make use of all possible formatting (for example font, color etc.). |
| 2 | Develop and demonstrate the usage of inline, internal and external style sheet using CSS |
| 3 | Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contains alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty). |
| 4 | Write a program to create and Build a star rating system using Jquery |
| 5 | Inheritance, Access Modifiers example using TypeScript and build simple website using it. |
| 6 | Create an application for Students Record using AngularJS |
| 7 | Create a Simple Login form using React JS<br>Create a blog using React JS (Using the CMS users must be able to design a web page using the drag and drop method. Users should be able to add textual or media content into placeholders that are attached to locations on the web page using drag and drop method.) |

| | |
|---|---|
| 8 | Write a program to create a simple calculator Application using React JS<br>Create a blog using React JS (Using the CMS users must be able to design a web page using the drag and drop method. Users should be able to add textual or media content into placeholders that are attached to locations on the web page using drag and drop method.) |
| 9 | Building a simple web server: Students can learn the basics of Node.js by building a simple web server that serves static content. They can learn how to use the http module to create a server, and how to handle requests and responses. |
| 10 | Creating a real-time dashboard: Students can learn how to use Node.js to create a real-time dashboard that displays data in real-time. They can learn how to use websockets to create a twoway communication channel between the client and the server, and how to create interactive visualizations using libraries like D3.js |
| 11 | Building a simple Blog App which has features like articles list based on most commented or most liked, author profile page and article page with comment section and reaction button. Basically, this app must have 3 different filters, based on filter chosen, the listing component must render 3 different pages. Develop using React Hooks, React Routing, Pagination and other sorting techniques |
| 12 | Build a RESTful API using MongoDB. |

**Evaluation Scheme:**

***Semester End Examination (A):***

*Theory:*

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to **75 marks**.
2. Total duration allotted for writing the paper is 3 hrs.

*Laboratory:*

1. Oral and practical examination will be based on the entire syllabus of course DJ19ADC5014. including the practical performed during laboratory sessions of course DJ19ADL5014.
2. Oral and practical examination will be of **25 marks**.

***Continuous Assessment (B):***

**Theory:**
Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems.

Total duration allotted for writing each of the paper is 1 hr.

Average of the marks scored in both the two tests will be considered for final grading.

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<table>
<tr><td colspan="6">Program: Third Year B.Tech. in Artificial Intelligence & Data Science</td><td colspan="4">Semester : V</td></tr>
<tr><td colspan="6">Course : Environmental Studies</td><td colspan="4">Course Code: DJ19A3</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme<br>(Hours / week)</td><td colspan="6">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td colspan="3">-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="2">-</td></tr>
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</table>

**Pre-requisite:** Interest in Environment and its impact on Human

**Objectives:**

1. Understand environmental issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Familiarise environment related legislation

**Outcomes:** On completion of the course, learner will be able to:

1. Understand how human activities affect environment
2. Understand the various technology options that can make a difference

| Detailed Syllabus: (unit wise) | | |
|---|---|---|
| **Unit** | **Description** | **Duration** |
| **1** | **Social Issues and Environment:**<br><br>Ecological footprint and Carrying Capacity, Depleting nature of Environmental resources such as soil, water minerals and forests, Carbon emissions and Global Warming. | 4 |
| **2** | **Technological Growth for Sustainable Development:**<br><br>Social, Economical and Environmental aspects of Sustainable Development, Renewable Energy Harvesting, Concept of Carbon credit, Green Building, Power and functions of Central Pollution Control Board and State Pollution Control Board. | 4 |
| **3** | **Green Technology:**<br>History, Agenda, and Challenges Ahead. Sustainable Cloud Computing, and Risk Management, Sustainable Software Design, Data Center Energy Efficiency, Thin-Client and Energy Efficiency. | 5 |

## Books Recommended:

***Text books:***

1. Environmental Studies From Crisis to Cure, R. Rajagopalan, 2012
2. Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education, Erach Bharucha
3. Green Information Technology A Sustainable Approach, Mohammad Dastbaz, Colin Pattinson, Babak Akhgar, Morgan and Kaufman, Elsevier, 2015.

***Reference Books:***

1. Information Technologies in Environmental Engineering: New Trends and Challenges, Paulina Golinska, Marek Fortsch, Jorge Marx-Gómez, Springer, 2011.

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<table>
<tr><td colspan="5">Program: Third Year B.Tech. in Artificial Intelligence & Data Science</td><td colspan="6">Semester : V</td></tr>
<tr><td colspan="5">Course : Innovative Product Development-III (C)</td><td colspan="6">Course Code: DJ19ILL1</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme<br>(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">25</td></tr>
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</table>

**Objectives:**

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualise and create a successful product.

**Outcome: Learner will be able to:**

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which

could eventually prepare themselves to be successful entrepreneurs.

7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

**Guidelines for the proposed product design and development:**

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters V and VI.

**Guidelines for Assessment of the work:**

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.

- Distribution of term work marks during the subsequent semester shall be as given below:
    - o Marks awarded by the supervisor based on log-book :10
    - o Marks awarded by review committee: 10
    - o Quality of the write-up: 05

In the last review of the semester VI, the term work marks will be awarded as follows.

- Marks awarded by the supervisor (Considering technical paper writing): 15
- Marks awarded by the review committee: 10

**Review/progress monitoring committee may consider the following points during the assessment.**

- In the semester V, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.
    - First shall be for finalisation of the product selected.
    - Second shall be on finalisation of the proposed design of the product.
- In the semester VI, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.
    - First review is based on readiness of building the working prototype.
    - Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

- The semester reviews (V and VI) may be based on relevant points listed above, as applicable.

**Guidelines for Assessment of Semester Reviews:**

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV.Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester VI.



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