DEPARTMENT OFARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Curriculum and Syllabus for Minor Degree Programme

Name of the Minor Degree	**Data Science (DS)**
Minor Degree Offering Department	**AIDS**
Eligible Departments	**All branches except AIDS**

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
1	PE	U23MDAI101	Introduction to Data Analytics	3	0	0	3
2	PE	U23MDAI102	Introduction to Data Visualization	3	0	0	3
3	PE	U23MDAI103	Elements of AI	3	0	0	3
4	PE	U23MDAI104	Decision Support System	3	0	0	3
5	PE	U23MDAI105	Digital Marketing	2	0	2	3
6	PE	U23MDAI106	Advanced Database Technologies	2	0	2	3
TOTAL CREDITS							**18**

U23MDAI01	INTRODUCTION TO DATA ANALYTICS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- Understand and apply key concepts of data operations.
- Understand simple statistical models and the fundamentals of machine learning regression techniques.
- Understand and apply best practices in data science.

UNIT I INTRODUCTION OF DATA OPERATIONS 9

Introduction, Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.

UNIT II DATA ANALYSIS 9

Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p- values

UNIT III SUPERVISED LEARNING 9

Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples

UNIT IV REGRESSION ANALYSIS 9

Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study.

UNIT V NETWORK ANALYSIS 9

Network Analysis, Graphs, Social Networks, centrality, drawing centrality of Graphs, PageRank, Ego-Networks, community Detection

TOTAL:45 PERIODS

TEXT BOOKS:

1 Joel Grus, "Data Science from Scratch: First Principles with Python", 1st Edition, O'Reilly Media, 2019.

2 Wes McKinney, "Python for Data Analysis", 2nd Edition, O'Reilly Media, 2017.

REFERENCES:

1 Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", 1st Edition, MIT Press, 2017.

2 Martin Kleppmann., "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", 1st Edition, O'Reilly Media, 2017.

Approved
Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)

3 Paul Crickard, "Data Engineering with Python", 1st Edition, O'Reilly Media, 2020.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/data-analytics-introduction

2 https://archive.nptel.ac.in/courses/110/106/110106064

3 https://www.simplilearn.com/data-analyst-masters-certification-training-course

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe what Data Science is and the skill sets needed to be a data scientist

CO2 Explain the significance of exploratory data analysis (EDA) in data science

CO3 Describe to learn the supervised learning, SVM

CO4 Apply basic machine learning algorithms (Linear Regression)

CO5 Explain the concepts of Networks, Graphs, PageRank and community Detection

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	-	-	1
CO3	2	2	1	1	2	1	-	-	-	-	-	1
CO4	3	3	2	1	-	1	-	1	-	-	-	1
CO5	2	2	1	1	-	1	-	-	-	-	-	1

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
GOWRIVAKKAM, CHENNAI - 600 073.

U23MD102 **INTRODUCTION TO DATA VISUALIZATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To Understand the fundamental principles of data visualization, including how visual representations of data can help people understand complex datasets
- To provide hands-on experience with the tools and technologies used to create data visualizations, as well as knowledge of various visualization types.
- To introduce students to interactive data visualizations that allow users to explore data on their own.

UNIT I **INTRODUCTION TO DATA VISUALIZATIONS AND PERCEPTION** **9**

Introduction of visual perception, visual representation of data, Gestalt principles, Information overload. Data foundation : Types of data – Structure within and between records – Data preprocessing – Human perceptions and information processing

UNIT II **VISUAL REPRESENTATIONS** **9**

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications , various visual representation , visual reference model and mapping the different applications of visualizations

UNIT III **CLASSIFICATION OF VISUALIZATION SYSTEMS** **9**

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents, different types of visualization systems. various types of data Interaction and visualization techniques

UNIT IV **DATA VISUALIZATION TECHNIQUES AND STRUCTURES** **9**

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization. visualization for different structures various visualization techniques data visualizations using data structures

UNIT V **VISUALIZATION OF GROUPS** **9**

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations ,visualization of maps. GIS systems and Collaborative visualizations

TOTAL:45 PERIODS

TEXT BOOKS:

1 Edward R Tufte, "The Visual Display of Quantitative Information", 2nd Edition, Graphic Press, 2019.

2 Cole Nussbaumer Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals", 1st Edition, O'Reilly Media, 2017.

Approved

Dr. G. DURGADEVI, M.E.,Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
GOWRIVAKKAM, CHENNAI - 600 073.

REFERENCES:

1 Nathan Yau, "Data Points: Visualization That Means Something", 1st Edition, O'Reilly Media, 2017.

2 Scott Murray, "Interactive Data Visualization for the Web: An Introduction to Designing with D3", 1st Edition, Media Press, 2018.

3 Andy Kirk "Data Visualization: A Successful Design Process", 1st Edition, Sage Publications, 2020.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/datavisualization

2 https://introductiontodatavisualization.commons.gc.cuny.edu/

3 http://kcl.digimat.in/nptel/courses/video/106106179/L11.html

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Identify the visual perception and representation of data.

CO2 Illustrate about projections of different views of objects.

CO3 Apply various Interaction and visualization techniques.

CO4 Analyze various groups for visualization.

CO5 Evaluate the visualizations of Groups

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	1	-	-	-	-	-	1	2	2
CO2	2	2	2	1	-	1	-	-	-	-	-	1	2	2
CO3	3	2	1	2	1	1	-	-	-	-	-	1	2	2
CO4	3	3	2	2	-	1	-	1	-	-	-	1	2	2
CO5	3	3	2	3	-	1	-	-	-	-	-	1	2	2

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Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
GOWRIVAKKAM, CHENNAI - 600 073.

U23MDAI03	ELEMENTS OF AI	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To Understand the Foundations of Deep Learning visual representations of data can help people understand complex datasets
- To Learn the Key concepts of Deep Learning Models and Architectures
- To introduce students to Gain Practical Experience in Training Deep Learning Models

UNIT I INTRODUCTION 9

Overview of Deep Learning : History and evolution of deep learning. Differences between traditional machine learning and deep learning. Real-world applications (e.g., image recognition, natural language processing).Artificial Neural Networks (ANNs): Basic structure and components of a neural network (neurons, layers, weights, biases).Activation functions (e.g., sigmoid, ReLU, tanh).Forward propagation.

UNIT II FUNDAMENTALS OF NEURAL NETWORKS 9

Feedforward Neural Networks (FNNs) Architecture of a simple neural network. Forward pass and backward pass. Loss functions (e.g., Mean Squared Error, Cross-Entropy). Backpropagation Algorithm Concept of back-propagation. Gradient descent optimization and variants (stochastic, mini-batch).Understanding gradients, chain rule, and weight updates. Optimization Techniques Learning rate, momentum, and optimization methods like Adam, SGD, and RMSprop.

UNIT III CONVOLUTIONAL NEURAL NETWORKS (CNNs) 9

Introduction to CNNs Convolution and pooling operations. Filters, kernels, and feature maps. Architecture of CNNs layers in CNNs: Convolutional layer, pooling layer, fully connected layer. Use cases in image classification, object detection, and image segmentation. Advanced CNN Architectures AlexNet, VGGNet, GoogLeNet, ResNet ,Transfer learning with pre-trained models.

UNIT IV RECURRENT NEURAL NETWORKS (RNNS) 9

Introduction to RNNs RNN architecture and the concept of sequential data. Training RNNs and challenges like vanishing and exploding gradients. Long Short-Term Memory (LSTM)Understanding LSTM architecture and how it addresses the vanishing gradient problem. Applications in time-series forecasting and natural language processing. Gated Recurrent Unit (GRU) Comparison of GRU and LSTM architectures.

UNIT V ADVANCED DEEP LEARNING ARCHITECTURES 9

Autoencoders Structure and applications of auto-encoders. Variational auto-encoders (VAE) and their applications in generative models. Generative Adversarial Networks (GANs)Overview of GANs: Generator and Discriminator. Training GANs and challenges. Applications GANs in image generation, deep fakes, and data augmentation. Transformer Networks . Introduction the Transformer model (Attention mechanism).Applications in NLP: BERT, GPT, and their variants

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Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY

TOTAL:45 PERIODS

TEXT BOOKS:

1 Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm", O'Reilly Media, 2020.

2 Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2021.

REFERENCES:

1 AurélienGéron, "Hands-On Machine Learning with Scikit- Learn and TensorFlow", O'Reilly, 2020.

2 Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress, 2019.

3 Charu Aggarwal, "Neural Networks and Deep Learning: A Textbook", 1st Edition, Springer, 2020.

ONLINE RESOURCES:

1. https://www.youtube.com/nptel.ac.in/courses/watch?v=aPfkYu_qiF4
2. https://www.youtube.com/nptel.ac.in/courses/watch?v=W3_yaf3HvHU
3. http://kcl.digimat.in/nptel/courses/watch?v=ctg14QIspRo

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the Fundamentals of Deep Learning Concepts

CO2 Explain about the fundamentals of Neural Networks

CO3 Apply various Interaction Architectures of Convolutional Neural Networks.

CO4 Explain the various groups for Recurrent Neural Networks.

CO5 Explain the advanced Deep Learning Architecture

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	-	-	1
CO3	3	2	1	1	1	1	-	-	-	-	-	1
CO4	2	2	1	1	-	1	-	1	-	-	-	1
CO5	2	2	1	1	-	1	-	-	-	-	-	1

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
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U23MDAI04	DECISION SUPPORT SYSTEMS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To Understand the concept of managerial decision systems
- To Learn the Key concepts of DSS components and identify sources of data for business intelligence
- To Gain the Categorize the methodologies involved in DSS development

UNIT I DECISION MAKING 9

Managerial decision making and information systems - framework and concept for decision support, Decision making - introduction – definition - systems and models, phases of decision making process - Personality Types – Gender - Human Cognition - and Decision Styles.

UNIT II MODELING AND ANALYSIS 9

Definition – Characteristics and capabilities of DSS – DSS components - Modeling and issues – Static and dynamic models – Certainty, Uncertainty and Risk – Influence Diagrams – Structure of Mathematical models

UNIT III DSS DEVELOPMENT 9

Introduction – Traditional and alternative development methodologies - Change Management – DSS Technology Levels and Tools – Development Platforms – Tool Selection.

UNIT IV ENTERPRISE DSS AND KNOWLEDGE MANAGEMENT 9

Communication support – Collaboration support - Group support systems and technologies – GSS meeting process – Creativity and idea generation – Enterprise information systems – Evolution – Characteristics and capabilities of executive support systems – Organizational DSS - Organizational learning and transformation – Knowledge management initiatives – approaches – implementation.

UNIT V BUSINESS INTELLIGENCE 9

Nature and Sources of data – Data collection, problems and quality – Database organizations and structures -Data warehousing, Data mining and Data visualization.

TOTAL:45 PERIODS

TEXT BOOKS:

1 Efraim Turban, Jay E Aronson, Ting Peng Liang, "Decision Support and Intelligent Systems", 7th Edition, Prentice Hall of India, 2021.

2 I Elain Rich, Kevin Knight, "Artificial intelligence", Tata McGraw-Hill, 2020.

REFERENCES:

1 Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision support and Business

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
GOWRIVAKKAM, CHENNAI - 600 073.

Intelligence systems", 9th Edition, Pearson Education, 2021.

2 Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress, 2021.

3 Efraim Turban, Decision Support Systems and Intelligent Systems", 9th Edition, Pearson, 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc20_mg59/preview

2 https://www.coursera.org/learn/wharton-decision-making-scenarios

3 https://enine.digimat.in/nptel/courses/video/109104198/L01.html

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the concept of managerial decision systems and outline its various phases.

CO2 Apply the DSS components and identify sources of data for business intelligence.

CO3 Analyze the methodologies involved in DSS development

CO4 Analyze evolution of enterprise DSS and knowledge management initiatives.

CO5 Describe the concepts of Business Intelligence , Problems and Quality

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	-	-	1
CO3	3	3	2	2	-	1	-	-	-	-	-	1
CO4	3	3	2	2	1	1	-	1	-	-	-	1
CO5	2	2	1	1	-	1	-	-	-	-	-	1

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
(An AUTONOMOUS INSTITUTION)
Chennimalai, CHENNAI - 600 073.

U23MDAI05	DIGITAL MARKETTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To Understand the Fundamentals of Digital Marketing
- To Learn the Key concepts and Ability to design and execute strategies across various digital platforms to achieve business goals.
- To Learn how to create and distribute valuable, relevant, and consistent content to attract and engage a target audience.

UNIT I INTRODUCTION 6

introduction to Digital Marketing (DM)-Meaning, Definition, Need of DM, Scope of DM, History of DM, Concept and approaches to DM, Examples of good practices in DM.

UNIT II MARKETING AUTOMATION 6

Definition, Advantages, Marketing Automation Software: CRM, Sales force, Analytics; Customer Experience (CX), How does marketing automation help marketers, Marketing automation tools.

UNIT III DIGITAL MARKETING MIX 6

Online Advertising, Lead Generation, Social Media Marketing, Content and Copywriting. Influencer Marketing: Influencer, Payment to Influencer, difference between influencer marketing and celebrity endorsements.

UNIT IV EMAIL MARKETING 6

Need for Emails, Types of Emails, options in Email advertising, Features of MailChimp, Mobile Marketing: Overview of the B2B and B2C Mobile Marketing.

UNIT V BLOGS 6

What are Blogs, Importance of Blogs, Personal Blogs, Corporate Blogs, Popular Blog Platforms, What are Tags, Widgets, Blog Optimization, and Blog Stats.

30 PERIODS

TEXT BOOKS:

1. Dave Evans, Susan Bratton, "Social Media Marketing: The Next Generation of Business Engagement", 3rd Edition, John Wiley & Sons, 2021.
2. Ryan Robinson , "How To Start a Blog", Tata McGraw-Hill, 2022.

REFERENCES:

1. George Pain, "Marketing Automation and Online Marketing", 4th Edition, Pearson Education, 2021.
2. Nikhil Ketkar, "Marketing AI: From Automation to Revenue Performance Marketing ", 2nd Edition, John Wiley & Sons, 2022.
3. Michael J Thibault, " The Influencer Blueprint: A Step-by-Step Guide to Harnessing the Power of Influencer Marketing for Business Success", 5th Edition, Pearson Education, 2022.

Approved
Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF ENGINEERING AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)

ONLINE RESOURCES:

1 https://www.coursera.org/specializations/digital-marketing

2 https://www.guvi.in/zen-class/digital-marketing-course/

3 https://www.udemy.com/courses/marketing/digital-marketing/

PRACTICAL EXERCISES: **30 PERIODS**

1 Evaluate a business's website, social media pages, and online ads to assess its digital marketing strategy and suggest improvements

2 Sign up for a free CRM tool (e.g., HubSpot, Zoho), add sample customer data, and explore its features.

3 Design a flowchart showing how marketing automation enhances customer experience with automated emails and follow-ups.

4 Create a basic online advertisement using Canva or Photoshop with a headline, image, and call-to-action.

5 Develop a sample social media post (text + image) promoting a product or service with an engaging caption and relevant hashtags.

6 Sign up for a free MailChimp account, create a basic email campaign, and explore features like templates and automation.

7 Set up a blog on WordPress, Blogger, or Medium, write a 200–300 word post, and add tags and categories for organization

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the key concepts, tools, and techniques used in digital marketing

CO2 Describe the Marketing Automation , Customer Relationship Management and Customers Experiences

CO3 Explain the concept of lead generation , the role of social media in digital marketing, different compensation models for influencer marketing

CO4 Create and implement targeted email marketing campaigns, applying segmentation strategies.

CO5 Analyze the importance of blogs for businesses and individuals in building authority, fostering customer relationships

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	-	-	1
CO3	2	2	1	1	-	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	1	-	-	-	1
CO5	3	3	2	2	1	1	-	1	-	-	-	1

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
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U23MDAI06	ADVANCED DATABASE TECHNOLOGIES	L	T	P	C
		3	0	2	3

COURSE OBJECTIVES:

- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML, Cloud and Big Data.

UNIT I PARALLEL AND DISTRIBUTED DATABASES 6

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies .

UNIT II INTELLIGENT DATABASES 6

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy – Applications -Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases TSQL2-Deductive Databases - Recursive Queries in SQL - Spatial Databases- Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.

UNIT III OBJECT AND XML DATABASES 6

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance. XML Databases: XML - Related Technologies - XML Schema - XML Query Languages - Storing XML in Databases - XML and SQL

UNIT IV MOBILE AND MULTIMEDIA DATABASES 6

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management -Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control -Transaction Commit Protocols - Multimedia Databases - Image Databases – Audio Databases - Video Databases.

UNIT V EMERGING TECHNOLOGIES 6

Web Databases - Geographic Information Systems - Biological Data Management - Cloud Based Databases: Data Storage Systems on the Cloud - Cloud Storage Architectures - Cloud Data Models- Query Languages - Introduction to Big Data-Storage - Analysis

30 PERIODS

TEXT BOOKS:

1 Henry F Korth, Abraham Silberschatz, S Sudharshan, "Database System concepts", 6th Edition, Tata McGraw Hill, 2021.

2 R Elmasri, S B Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education, 2022.

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
ENGINEERING AND TECHNOLOGY
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REFERENCES:

1 Thomas Cannolly, Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3rd Edition, Pearson Education, 2021.

2 C J Date, A Kannan, S Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2020.

3 Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2019.

ONLINE RESOURCES:

1 https://gec.digimat.in/nptel/courses/video/106102237/L21.html

2 https://onlinecourses.nptel.ac.in/noc22_cs91

3 https://archive.nptel.ac.in/courses/106/105/106105175/

PRACTICAL EXERCISES: **30 PERIODS**

1 Set up replication between two database instances. Insert data in the primary database and check if it is automatically replicated in the secondary database.

2 Create a simple bank account transfer system where two transactions update the same account balance. Implement a locking mechanism to prevent data inconsistencies due to concurrent updates.

3 Create a Manager Employee table with hierarchical relationships (EmpID, Name, ManagerID) and write a recursive SQL query to retrieve all employees under a specific manager

4 Create a table for Employee with columns EmpID, Name, Salary and write a trigger that automatically logs changes to the salary in an Audit Log table whenever it is updated.

5 Write an XML file representing student data. Convert and store the data in a relational table using SQL queries.

6 Create a database table to store images with metadata (e.g., ImageID, FileName, Upload Date) and write an SQL query to retrieve all images uploaded within the last 7 days.

7 Create a simple biological database table (e.g., storing DNA sequences or patient records) and write SQL queries to retrieve sequences based on specific conditions.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the usage of high performance database like parallel and distributed database.

CO2 Explain the real world data using object oriented database.

CO3 Apply the rule set in the database to implement intelligent databases.

CO4 Analyze the data using XML database for better interoperability.

CO5 Describe use of big data and store in a transparent manner in the cloud.

Approved

Dr. G. DURGADEVI, M.E., Ph.D.,
DEAN - ACADEMICS,
NEW PRINCE SHRI BHAVANI COLLEGE OF
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CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	-	-	-	-	1
CO2	2	2	1	1	-	1	-	-	-	-	-	1
CO3	3	2	1	2	1	1	-	1	-	-	-	1
CO4	3	3	2	2	1	1	-	1	-	-	-	1
CO5	2	2	1	1	-	1	-	-	-	-	-	1

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