Nagarjuna College of Engineering & Technology, Bengaluru

An Autonomous Institute, Affiliated to VTU Belagavi

2023 Batch
Scheme & Syllabus of
VI Semester

As per the NEP 2020 Guidelines,
Choice-Based Credit System
&
Outcome-Based Education

CSE (Data Science)

w.e.f.
Academic Year 2025-2026

Vision:

To build a strong technical environment and foster leadership and problem-solving abilities in the domain of Data Science, creating professionals capable of addressing social and technical challenges

Mission:

1. To equip and expose students with the latest tools and technologies.
2. To instill critical problem-solving capabilities, leadership qualities, research capabilities and to prepare them for global challenges.
3. To establish state-of-the-art laboratories and foster collaborations with leading industries in the field of Data Science.

PROGRAM OUTCOMES (POs): Graduates of the Computer Science and Engineering – Data Science Program will be able to achieve the following.

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in Washington Accord Knowledge 1 (WK1) to Washington Accord Knowledge 4 (WK4) respectively to develop the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

i) Independent and life-long learning.
ii) Adaptability to new and emerging technologies and
iii) Critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcome (PSO)

PSO1: Analyze complex computing problems and apply to derive appropriate solutions.

PSO2: Design, implement, and evaluate database-oriented, computing-based solutions that address a broad range of requirements in the field of Data Science.

PSO3: Communicate and work effectively within diverse teams and professional environments.

Program Educational Objectives (PEOs)

PEO1: To work as Data Scientist with an ability to solve wide range of computational problems.

PEO2: To work effectively in a diverse and multi-disciplinary field, as a team member or leader to solve the societal problems.

PEO3: Engage in self-directed and lifelong learning, continuously updating their skills by adapting emerging techniques, advancing in research and higher studies.

NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY, BENGALURU

B.E. in CSE (Data Science)

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2025-26)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week					Examination			
					Theory Lecture	Tutorial	Practical / Drawing	Self Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
					L	T	P	S					
1	IPCC	23CDI61	Big Data Analytics	TD: CD PSB : CD	3	0	2		03	50	50	100	4
2	PCC	23CDT62	Artificial Intelligence & Machine Learning	TD: CD PSB : CD	4	0	0		03	50	50	100	4
3	PEC	23CDT63*	Professional Elective Course	TD: CD PSB : CD	3	0	0		03	50	50	100	3
4	OEC	23CDO64*	Open Elective Course	TD: CD PSB : CD	3	0	0		03	50	50	100	3
5	PROJ	23CDP65	Project Phase I	TD: CD PSB : CD	0	0	4		03	100	--	100	2
6	PCCL	23CDL66	Machine Learning Lab	TD: CD PSB : CD	0	0	2		03	50	50	100	1
7	AEC/ SDC	23CDT67*	Ability Enhancement Course/Skill Development Course V	TD and PSB: Concerned department	If the course is offered as a Theory: 1	0	0		03	50	50	100	1
					If course is offered as a practical: 0	0	2						
8	MC	23NS69	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	--	100	0
		23PE69	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		23YO69	Yoga	Yoga Teacher									
9	MC	23IKS68	Indian Knowledge System		1	0	0		01	100	--	100	0
									Total	**600**	**300**	**900**	**18**

Professional Elective Course

23CDT631	Natural Language Processing	23CDT633	Blockchain Technology	23CDT635	Prompt Engineering
23CDT632	Data Engineering	23CDT634	Time Series Analysis		

Open Elective Course

23CDO641	Introduction to DBMS	23CDO643	Mobile Application Development
23CDO642	Fundamentals of Operating Systems	23CDO644	Introduction to Data Structures

Ability Enhancement Course/Skill Development Course-V

23CDT671	AWS	23CDT675	Data Analytics
23CDT672	Application Development using React and React Native	23CDT676	ServiceNow
23CDT673	Cyber Security	23CDT677	Google Flutter
23CDT674	Salesforce		

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional ElectiveCourse. **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 :

2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governingthe Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall
not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

BIG DATA ANALYTICS

Course Code	**23CDI61**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Pre- Requisites:

Basic Knowledge of Database Management and SQL
Data Warehousing Concepts
Programming Skills – Python or Scala

Course objectives:

1. Understanding Big Data concepts and Technologies.
2. Master Big Data Storage and Processing Frameworks.
3. Develop skills in Data processing.
4. Gain practical Hands-on experience.

Teaching – Learning Process:

These are sample Strategies, used in Game design using Unity to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Google site web links of the concept are sent to students well in advance so that students will be able to grasp the topics that is taken in class.
3. After the class quiz is been asked in the class with respect to the topics to know their understanding level and which also promotes critical thinking.
4. Experience Based Learning (EBL) id adopted, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
5. Every concept can be applied to the real world – and when that's possible, is taught in the class which helps improve the student's understanding.

Module – I

Introduction to Big Data Analytics and HDFS: Definition of Big data and Analytics, A Brief History of Hadoop, Characteristics of Big Data, Examples of Big Data, RDBMS Vs Hadoop, Introduction to Hadoop Eco system, HDFS Concepts – Blocks, NameNode and Datanodes, HDFS high availability, Anatomy of File Read&Write, Basic HDFS file system operations.

08 Hours

Module – II

HIVE & YARN: what is Hive, Hive Architecture, Query Life cycle, Hive data types, Hive file formats, Hive Tables, Partitions and Buckets, HQL – Querying Data using beeline, YARN Architecture, Application Life cycle, Schedulers, Sample Yarn job Demonstration.

08 Hours

Module – III

Introduction to Data Analysis with Spark: Introduction to Apache Spark, Spark Architecture, Programming with RDDs: RDD Basics, Creating RDDs, RDD Transformations & Actions, Shared Variables – Broadcast Variables & Accumulators, Introduction to Spark SQL, Spark Session fundamentals, DataFrame Fundamentals, DataFrame Rows & Columns.

08 Hours

Module – IV

MongoDB: Introduction to NoSQL databases and MongoDB, Terms used in MongoDB, MongoDB Query Language: CRUD (Create, Read, Update and Delete) operations, Querying, Indexing, Aggregation Framework, Performance – Best Practices.

08 Hours

Module – V

Snowflake: Snowflake architecture, Snowflake editions, setting up Warehouse, Scaling policies, Types of Snowflake Tables, Working with Stages, Loading Data, copy options, loading data from cloud, Zero Copy

Cloning, Data sharing, Snowflake Tasks, Snowflake Time Travel & Fail safe.

08 Hours

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

PRACTICAL COMPONENT OF IPCC

Sl.No	**Experiments**
1	Perform basic HDFS file system operations such as creating directories, uploading files from local system to HDFS, listing files, viewing file contents, and deleting files. Understand how data is stored and managed in HDFS.
2	Demonstrate the HDFS file read and write process by storing a large file in HDFS. Observe block size, replication factor, and how data is distributed across DataNode.
3	Create a Hive database and table using HQL and load data from a CSV file. Execute simple SELECT queries to retrieve and analyze the data.
4	Create a partitioned Hive table and load data into different partitions. Execute aggregation queries and observe how Hive jobs are executed using YARN.
5	Write a Spark program to create RDDs from a collection or file. Apply basic transformations and actions to process the data in a distributed manner.
6	Create Spark Data Frames from structured data files and perform data analysis using Spark SQL. Execute queries to filter, group, and summarize the data.
7	Create a MongoDB database and collection and perform CRUD operations such as insert, find, update, and deleting documents. Understand how data is stored in document format.
8	Use MongoDB aggregation framework to perform data analysis operations such as grouping and calculating totals. Create indexes and observe their impact on query performance.
9	Create Snowflake warehouse, database, and tables and load data using internal stages. Use COPY command to load data from files into Snowflake tables.
10	Demonstrate Snowflake Time Travel to query historical data and recover deleted records. Create a zero-copy clone of a table and verify that data is shared without duplication.

Course Outcomes:

At the end of the course the student will be able to:

CO1: Understand the fundamentals of Big Data Analytics.

CO2: Apply the concepts of NoSQL using MongoDB , Spark for Big Data task.

CO3: Analyze the concepts of Hadoop and Snowflake to obtain solution for a given problem.

CO4: Illustrate the components of Hadoop, NoSQL and Snowflake for Big Data Analytics.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	Total 25 Marks : Reduced to 15 Marks	
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
	Total 25 Marks : Reduced to 10 Marks	
Lab Component	Lab Record and execution of programs	**15 Marks**
	Lab Test at the end of 15th week	**10 Marks**
	Total	**25 Marks**
Grand Total of IAT Marks		**50 Marks**
Obtaining 40% of marks in both theory and lab component is essential for appearing for SEE		

Suggested Learning Resources:

Text Books:

1. Big Data Science & Analytics – A Hands-on Approach by Arshdeep Bahga, Vijay Madisetti, 1st edition,

VPT publisher, 2018
2. Big Data and Analytics by Seema Acharya, Subjashini Chellappan 1st edition, Wiley 2010
3. Scala for the Impatient Cay S. Horstmann 2nd edition,Addison Wesley Professional 2016
4. Learning Spark Lightning-Fast Big Data Analysis bys Andy Konwinski, Holden Karau, MateiZaharia, Patrick Wendell 1st edition, O'Reilly 2015

Reference Books:

1. Hadoop: The Definitive Guide by Tom White.
2. Big Data Analytics, Introduction to Hadoop, Spark, and Machine Learning by Raj Kamal, Preeti Saxena 1st McGraw Hill 2019.
3. Spark: The Definitive Guide by Bill Chambers and Matei Zaharia.
4. Snowflake: The Definitive Guide by Joyce Kay Avila.
5. MongoDB: The Definitive Guide by Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow.

E – Resources:

1. https://www.ijaeast.com/Introduction%20to%20Big%20Data%20Analytics.pdf
2. https://www.udemy.com/course/hadoopstarterkit/
3. https://nptel.ac.in/courses/10 6104189

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**23CDT62**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**4:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**50**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course objectives:

- Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving.
- Explore the basics of Machine Learning & Machine Learning process, understanding data.
- Understand the Working of Artificial Neural Networks.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction: What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence, Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents. Search Strategies: BFS, DFS, A* Algorithm. Game Playing: Minimax Algorithm.

Examples & Applications:

1. AI in Healthcare (Disease Prediction)
2. AI in Finance (Fraud Detection)

Case Study:

IBM Watson in Healthcare: How AI assists doctors in diagnosing diseases. **10 Hours**

Module – II

Fundamentals of Machine Learning

Introduction to Machine Learning: Types (Supervised, Unsupervised, Reinforcement Learning) Regression Models: Linear and Logistic Regression. Univariate and Multivariate. Performance Metrics: Accuracy, Precision, Recall, F1 Score. Overfitting and Underfitting, Bias-Variance Tradeoff

Examples & Applications:

1. Predicting House Prices using Linear Regression
2. Spam Detection in Emails using Logistic Regression

Case Study:

Netflix Recommendation System: How ML personalizes movie recommendations. **10 Hours**

Module – III

Machine Learning Algorithms (Supervised & Unsupervised Learning):

Classification Techniques: Decision Trees, Random Forest, and Support Vector Machines (SVM), k-Nearest Neighbors (k-NN) Algorithm **Clustering**: K-Means, Hierarchical Clustering, Principal Component Analysis (PCA), Feature Engineering & Feature Selection

Examples & Applications:

1. Customer Segmentation using K-Means
2. Sentiment Analysis using Decision Trees

Case Study:

Facebook Friend Recommendation System: How clustering is used to suggest friends. **10 Hours**

Module – IV

Deep Learning, Reinforcement Learning and Neural Networks

Introduction to Deep Learning: Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN) for Image Processing, Recurrent Neural Networks (RNN) for Sequential Data, Activation Functions (ReLU, Sigmoid, Softmax), Reinforcement Learning: Q-Learning and Deep Q Networks

Examples & Applications:

1. Image Classification using CNN (e.g., Cat vs Dog Classifier)
2. Speech Recognition using RNN

Case Study:

Google DeepMind's AlphaGo: How AI mastered the game of Go. **10 Hours**

Module – V

AI Ethics & Real-World AI

Ethical Issues in AI: Bias, Privacy, Fairness Explainable AI (XAI), AI for Social Good (AI in Climate Change, Education), Future Trends in AI & ML: Generative AI (GANs, Transformers), AI for Edge Computing and IoT, Quantum Machine Learning

Examples & Applications:

1. AI Chatbots (e.g., OpenAI's ChatGPT, Google Bard)
2. AI in Self-Driving Cars (Tesla Autopilot)

Case Study:

AI in Criminal Justice: Examining how AI is used in predictive policing and the ethical concerns involved. **10 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to :

CO1: Illustrate the fundamental concepts of Artificial Intelligence.

CO2: Apply machine learning fundamentals and regression techniques to solve prediction problems.

CO3: Develop supervised and unsupervised learning models using classification and clustering algorithms for data analysis tasks.

CO4: Design deep learning and reinforcement learning models for image, speech, and sequential data applications.

CO5: Analyze ethical issues, societal impact, and emerging trends in real-world Artificial Intelligence applications.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2015.
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford University Press, 2021.

Reference:

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980, ISBN: 978-3-540-11340-9
3. Murty, M. N., and V. S. Ananthanarayana. Machine Learning: Theory and Practice, Universities Press, 2024.

Weblinks and Video Lectures (e-Resources):

1. Problem solving agent:https://www.youtube.com/watch?v=KTPmo-KsOis
2.https://www.youtube.com/watch?v=X_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSH cH
3. https://www.javatpoint.com/history-of-artificial-intelligence
4. https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
5. https://techvidvan.com/tutorials/ai-heuristic-search/
6. https://www.analyticsvidhya.com/machine-learning/
7. https://www.hackerearth.com/practice/machine-learning/machine-learningalgorithms/mldecision-tree/tutorial/
8. https://www.javatpoint.com/unsupervised-artificial-neural-networks

NATURAL LANGUAGE PROCESSING (PE)

Course Code	**23CDT631**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

- Learn the importance of natural language modeling.
- Understand the applications of natural language processing.
- Study spelling, error detection and correction methods and parsing techniques in NLP.
- Illustrate the information retrieval models in natural language processing.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction: What is Natural Language Processing?, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications.

Language Modeling: Statistical Language Model - N-gram model (unigram, bigram), Paninian Framework.

08 Hours

Module – II

Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging.

Syntactic Analysis: Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing.

08 Hours

Module – III

Naive Bayes, Text Classification and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model.

08 Hours

Module – IV

Information Retrieval: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model**,** Major Issues in Information Retrieval.

Lexical Resources: WordNet, FrameNet, Stemmers, Research Corpora.

08 Hours

Module – V

Machine Translation: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues.

08 Hours

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to:

CO1: **Understand** the fundamental concepts of Natural Language Processing, including grammar-based and statistical language models.

CO2: **Analyze** morphological analysis techniques and syntactic parsing approaches used in Natural Language Processing

CO3: **Formulate** Naïve Bayes classifiers and sentiment analysis techniques for natural language problems and text classification.

CO4: **Apply** information retrieval techniques, lexical semantics, and lexical resources for NLP tasks

CO5: **Demonstrate** understanding of machine translation concepts.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Daniel Jurafsky, James H. Martin, "Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2023.

Reference Books:

1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019.
2. T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw
4. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
5. https://archive.nptel.ac.in/courses/106/106/106106211/

DATA ENGINEERING (PE)			
Course Code	**23CDT632**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Objectives:

At the end of the course, the student will be able to :

1. Learn the concepts of data engineering and its fundamentals that maps the data science domain.
2. Understand the data modeling techniques, data governance and compliance.
3. Apply the knowledge of the data engineering in various applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

INTRODUCTION TO DATA ENGINEERING: Overview of Data Engineering, Role of a Data Engineer, Data Engineering vs. Data Science, Data Lifecycle Management, Data Architecture and Infrastructure, Introduction to Big Data, Characteristics of Big Data, Tools and Technologies in Data Engineering.

Text Book 1: Chapter 1

Self Study: Explore the latest trends and advancements shaping the field of data engineering, including technological innovations, industry practices, and evolving roles and responsibilities.

08 Hours

Module – II

DATA MODELING AND DATABASE DESIGN: Data Modeling Concepts, Dimensional Modeling, SQL and NoSQL Databases, Relational Database Management Systems (RDBMS), Document Stores, Key-Value Stores, Column-Family Stores, Graph Databases, Normalization and Denormalization, Indexing and Query Optimization.

Text Book 2: Chapter 4,7

Case Study: Design a dimensional model for an online retail company aiming to optimize its business operations and customer experience. Discuss the normalization and demoralization strategies, indexing techniques, and database technology choices, considering scalability and performance requirements. Evaluate the potential use of graph databases for analyzing customer-product relationships.

08 Hours

Module – III

DATA WAREHOUSING AND ETL PROCESSES: Data Warehousing Concepts, OLAP vs. OLTP, Data Warehouse Architecture, ETL (Extract, Transform, Load) Processes, ETL Tools and Techniques, Data Cleansing and Transformation, Data Lakes.

Text Book 3: Chapter 2,3

08 Hours

Module – IV

DATA INTEGRATION AND WORKFLOW MANAGEMENT: Data Integration Techniques, APIs, Webhooks, Data Connectors, Workflow Orchestration, Apache Airflow, Luigi, Prefect, Data Quality Management, Data Profiling, Data Quality Dimension.

Text Book 2: Chapter 11

08 Hours

Module – V

DATA GOVERNANCE AND COMPLIANCE: Data Governance Fundamentals, principles of Data Governance, Data Stewardship and Ownership, Regulatory Compliance, GDPR, CCPA, and Other Data Privacy Regulations, Industry-specific Compliance Requirements (e.g., HIPAA for Healthcare), Data Security and Encryption, Encryption Techniques and Best Practices, Secure Data Transmission and Storage, Auditing and Monitoring, Ethical Considerations.

Text Book 3: Chapter 1

08 Hours

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course outcomes:

At the end of the course, the student will be able to:

CO1: Understand core data engineering concepts and technologies in Data Engineering and data governance fundamentals stewardship, ownership, and adherence to regulatory compliance such as GDPR, CCPA.

CO2: Demonstrate the data modeling techniques and database design principles to create optimized database schemas for various applications.

CO3: Apply ETL processes to ensure data integrity and quality in data warehousing environments.

CO4: Examine data workflows using modern orchestration tools, ensuring data integration and quality across sources.

CO5: Analyze the concepts of data security, focusing on encryption techniques, monitoring and ethical considerations in data management.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Joe Reis , Matt Housley , Fundamentals of Data Engineering: Plan and Build Robust Data Systems (Grayscale Indian Edition) – 27 June 2022, ISBN-13, 978-9355421548.
2. Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom, DATABASE SYSTEMS, The Complete Book Second Edition 2019, ISBN-13, **978-0131873254.**
3. Mayank Malhotra, Ultimate Data Engineering with Databricks: Develop Scalable Data Pipelines Using Data Engineering's Core Tenets Such as Delta Tables, Ingestion,

Transformation, Security, and Scalability – Import, 14 February 2024, ISBN-13, **978-8196994785.**

Reference Books:

1. Roberto Zagni, Data Engineering with dbt: A practical guide to building a cloud-based, pragmatic, and dependable data platform with SQL,Second Edition,2023, ISBN-13978-1803246284.

Web links and Video Lectures (e-Resources):

1. https://www.datacamp.com/category/data-engineering
2. https://www.udemy.com/topic/data-engineering/
3. https://www.youtube.com/watch?v=hf2go3E2m8g
4. https://www.youtube.com/watch?v=ZRz-7E-7X7c

BLOCKCHAIN TECHNOLOGY (PE)			
Course Code	**23CDT633**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To Understand Blockchain terminologies with its applications. design
2. To learn working principles of Blockchain and methodologies used in Bitcoin
3. To gain knowledge on Ethereum Network, Wallets, Nodes, Smart contract & DApps
4. To learn blockchain Based Application Architecture using Hyperledger and the Smart Contract Lifecycle

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Chapter 1 **08 Hours**

Module – II

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization.

Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA).

Chapter 2, Chapter 3: pg:56-105 **08 Hours**

Module – III

Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block , The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO.

Chapter 4:pg:111-148, Chapter 6 **08 Hours**

Module – IV

Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain , Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network. Hands-on: Clients and wallets –Geth.

Chapter 7: pg: 210-227, 235-269 **08 Hours**

Module – V

Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda.

Chapter 9 **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to :

CO1: Explain the Blockchain terminologies with its applications. design

CO2: Illustrate the working principles of Blockchain and the Smart Contract Lifecycle

CO3: Demonstrate the principles and methodologies used in Bitcoin

CO4: Develop Ethereum Network, Wallets, Nodes, Smart contract and DApps.

CO5: Make use of Hyperledger in Blockchain Based Application Architecture.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Imran Bashir. “Mastring BlockChain”, Third Edition, Packt – 2020.

Reference Books:

1. Andreas M. , Mastering Bitcoin: Programming the Open Blockchain – O’rielly – 2017.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106104220
2. https://www.geeksforgeeks.org/blockchain/
3. https://www.tutorialspoint.com/blockchain/index.htm

TIME SERIES ANALYSIS (PE)			
Course Code	**23CDT634**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. Learn the importance of time series analysis on the data.
2. Identify approaches to handle linear stationary and non stationary models.
3. Analyse ways of model building and parameter estimation.
4. Recognize methods to handle multivariate time series data.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction, Five Important Practical Problems, **Autocorrelation Function and Spectrum of Stationary Processes:** Autocorrelation Properties of Stationary Models, Spectral Properties of Stationary Models, **Linear Stationary Models:** General Linear Process, Autoregressive Processes, Moving Average Processes, Mixed Autoregressive—Moving Average Processes.

Ch. 1.1, Ch. 2.1,2.2 Ch. 3.1,3.2,3.3,3.4 **08 Hours**

Module – II

Linear Nonstationary Models: Autoregressive Integrated Moving Average Processes, Three Explicit Forms for the ARIMA Model, Integrated Moving Average Processes.

Forecasting : Minimum Mean Square Error Forecasts and Their Properties, Calculating Forecasts and Probability Limits, Examples of Forecast Functions and Their Updating, Use of State-Space Model Formulation for Exact Forecasting

Ch. 4.1,4.2,4.3, Ch. 5.1,5.2,5.3,5.4,5.5. **08 Hours**

Module – III

Model Identification: Objectives of Identification, Identification Techniques, Initial Estimates for the Parameters, Model Multiplicity.

Parameter Estimation: Study of the Likelihood and Sum-of-Squares Functions, Nonlinear Estimation, Some Estimation Results for Specific Models, Likelihood Function Based on the State-Space Model, Estimation Using Bayes' Theorem

Ch. 6.1,6.2,6.3,6.4 Ch. 7.1,7.2,7.3,7.4,7.5. **08 Hours**

Module – IV

Model Diagnostic Checking: Checking the Stochastic Model, Overfitting, Diagnostic Checks Applied

to Residuals, Use of Residuals to Modify the Model,

Analysis of Seasonal Time Series: Parsimonious Models for Seasonal Time Series, Some Aspects of More General Seasonal ARIMA Models, Structural Component Models and Deterministic Seasonal Components, Regression Models with Time Series Error Terms.

Ch. 8.1,8.2,8.3 Ch. 9.1,9.2,9.3,9.4,9.5 **08 Hours**

Module – V

Multivariate Time Series Analysis: Stationary Multivariate Time Series, Vector Autoregressive Models, Vector Moving Average Models, Vector Autoregressive—Moving Average Models, Forecasting for Vector Autoregressive--Moving Average Processes, State- Space Form of the VARMA Model, Nonstationary and Cointegration

Ch. 14.1,14.2,14.3,14.4,14.5,14.6,14.8 **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to :

CO1: Apply the fundamental concept of Time series analysis for Autocorrelation Function and spectrum on linear stationary models.

CO2: Develop non-linear stationary models and perform forecasting.

CO3: Identify models and estimate the various parameters.

CO4: Recognize ways to perform model diagnostic checking and analyze the seasonal time series.

CO5: Analyze multivariate time series data.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, "Time Series Analysis – Forecasting and Control", Wiley Publications , 2016.

Reference Books:

1. Paul S.P. Cowpertwait and Andrew V. Metcalfe, Introductory Time Series with R, Springer Verlag, New York, 2009.

2. Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, One line, Open Access Textbooks.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/103106123
2. https://www.youtube.com/watch?v=GE3JOFwTWVM
3. https://www.youtube.com/watch?v=tepxdcepTbY
4. https://www.youtube.com/watch?v=rDwczdWBlTA

PROMPT ENGINEERING (PE)

Course Code	**23CDT635**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Prerequisites: Basic understanding of AI/ML concepts, familiarity with Python (recommended)

Course Overview

This comprehensive 40-hour course introduces students to the fundamentals and advanced concepts of Prompt Engineering, focusing on Large Language Models (LLMs) and Generative AI systems. The curriculum balances theoretical understanding with hands-on practical experience, preparing students for emerging career opportunities in AI engineering[1][2].

Course Objectives

1. Understand the fundamentals of Prompt Engineering, Large Language Models (LLMs), and Generative AI Systems.
2. Design structured and optimized prompts using advanced techniques such as Zero-short, Few-shot, Chain-of-Thought (CoT), Tree-of-Thought (ToT), and RAG.
3. Develop AI-powered applications by integrating LLM APIs, multimodal systems, and AI-assisted programming tools.
4. Implement context engineering, retrieval-based systems, and prompt optimization strategies for real-world problem solving.
5. Apply ethical, responsible and domain-specific prompt engineering practices while exploring career and monetization opportunities.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction to Prompt Engineering: What is Prompt Engineering?, Evolution of AI and Natural Language Processing, Understanding Large Language Models (LLMs), Career opportunities in Prompt Engineering, Ethical considerations in AI interactions.

Fundamentals of Prompt Design: Anatomy of effective prompts, Prompt structure and components, Context windows and token limitations, Delimiters and formatting techniques, Role-based prompting, Temperature and parameter tuning.

08 Hours

Module – II

Core Prompting Techniques: Zero-shot prompting, Few-shot prompting with examples, Chain-of-Thought (CoT) prompting, Tree-of-Thought (ToT) prompting, ReAct (Reasoning + Acting) framework, Self-consistency prompting, Meta-prompting strategies.

Multimodal Prompting: Introduction to multimodal AI models, Text-to-image prompting (DALL-E, Midjourney, Stable Diffusion), Image-to-text analysis, Vision-language models, Audio and video prompting, Cross-modal reasoning.

08 Hours

Module – III

Context Engineering and RAG: Understanding context windows, Context engineering strategies, Retrieval-Augmented Generation (RAG), Vector databases and embeddings, Fine-tuning vs RAG vs Prompt Engineering, Memory management in conversations, Information retrieval techniques.

AI-Assisted Programming: Using ChatGPT for code generation, GitHub Copilot and AI pair programming, Claude Code and Gemini CLI, Debugging with AI assistance, Code review and optimization, Vibe coding methodology, Security considerations in AI-generated code.

Building AI Applications: AI application architecture, API integration with OpenAI, Anthropic, Google, Building chatbots and conversational agents, No-code AI agent development, Prompt chaining for complex workflows, State management in AI applications, Error handling and fallback strategies.

08 Hours

Module – IV

Advanced Prompt Engineering: Prompt tuning and optimization, Adaptive prompting techniques, Active prompting and model feedback, Reasoning with advanced models (OpenAI O1), Reflection prompting, Constitutional AI and safety prompting, Adversarial prompting and jailbreaking prevention.

Domain-Specific Applications: Prompt engineering for education and e-learning, Healthcare and medical applications, Legal and compliance use cases, Marketing and content creation, Research and data analysis, Finance and business intelligence.

Ethics, Bias, and Best Practices: Ethical considerations in AI prompting, Bias detection and mitigation, Privacy and data security, Responsible AI usage guidelines, Transparency and explainability, Regulatory compliance (AI Act, GDPR).

08 Hours

Module – V

Monetization and Career Opportunities: Career paths in prompt engineering, Freelancing and consulting opportunities, Building AI products and SaaS, Prompt marketplaces and platforms, Skill development and continuous learning, Industry certifications and credentials.

Capstone Project: Case study

08 Hours

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course outcomes:

At the end of the course, the student will be able to:

CO1: Explain the architecture and working principles of LLMs and demonstrate basic prompt design techniques. (Understand level – Bloom's L2)

CO2: Construct effective prompts using advanced reasoning techniques such as CoT, ToT, ReAct and self-consistency for solving complex problems. (Apply level – Bloom's L3)

CO3: Develop context-aware AI systems using RAG, vector databases, and API integrations to build intelligent applications. (Apply/Create – Bloom's L3/L6)

CO4: Design and deploy AI-powered applications (chatbots, automation tools, multimodal systems) using prompt engineering methodologies. (Create level – Bloom's L6)

CO5: Evaluate AI systems for performance, bias, safety, and ethical compliance while optimizing prompts for domain-specific use cases. (Evaluate level – Bloom's L5)

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

References

[1] Coursera. (2025). Prompt Engineering for ChatGPT by Vanderbilt University. https://www.coursera.org/learn/prompt-engineering

[2] Coursera. (2024). Prompt Engineering Courses. https://www.coursera.org/courses?query=prompt+engineering

[3] Simplilearn. (2025, October 21). Prompt Engineering Full Course 2026 | Tutorial for Beginners. *YouTube*. https://www.youtube.com/watch?v=BUdwDOLQVWc

[4] Coursera. (2025). Prompt Engineering for ChatGPT. https://www.coursera.org/learn/prompt-engineering

[5] Phoenix, J., & Taylor, M. (2024). *Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs*. O'Reilly Media.

[6] Berryman, J., & Ziegler, A. (2024). *Prompt Engineering for LLMs: The Art and Science of Building Large Language Model-Based Applications*. O'Reilly Media.

[7] IBM. (2025). The 2026 Guide to Prompt Engineering. https://www.ibm.com/think/prompt-engineering

[8] TutorialsPoint. (2025). Prompt Engineering Tutorial. https://www.tutorialspoint.com/prompt_engineering/

[9] LaunchDarkly. (2026, January 27). Prompt Engineering Best Practices: Tutorial & Examples. https://launchdarkly.com/blog/prompt-engineering-best-practices/

[10] DigitalOcean. (2025, December 18). Prompt Engineering Best Practices: Tips, Tricks, and Tools. https://www.digitalocean.com/resources/articles/prompt-engineering-best-practices

[11] Zhou, Y. (2024). *Prompt Design Patterns*. Independent Publisher.

[12] Mizrahi, G. (2024). *Unlocking Secrets of Prompt Engineering*. Packt Publishing.

[13] Generative AI Masters. (2025, December 10). Prompt Engineering Roadmap 2026 for Beginners. https://generativeaimasters.in/prompt-engineering-roadmap/

[14] TechTarget. (2025, March 18). Prompt Engineering Tips and Best Practices. https://www.techtarget.com/searchenterpriseai/tip/Prompt-engineering-tips-and-best-practices

[15] Simplilearn. (2025, September 17). Prompt Engineering Full Course 2026. *YouTube*. https://www.youtube.com/watch?v=q1TEDBy3NbI

[16] Simplilearn. (2025, December 4). Prompt Engineering Full Course 2026 | Generative AI. *YouTube*. https://www.youtube.com/watch?v=DvhFcIRRXyI

[17] Lakshmanan, V., & Hapke, H. (2025). *Generative AI Design Patterns*. O'Reilly Media.

[18] Huang, K. (2024). *LLM Design Patterns*. Packt Publishing.

[19] Generative Programmer. (2025, December 27). Best Prompt Engineering Resources (2026 Edition). https://generativeprogrammer.com/p/best-prompt-engineering-resources

[20] Prompt Engineering.org. (2025). Complete Prompt Engineering Course | No Coding Experience. https://promptengineering.org/learn/

[21] Fernandez, O. (2024). *Patterns of Application Development Using AI*. Leanpub.

[22] Hawkins, A. (2024). *The Secret of Prompt Engineering: Master the Skill That Can Earn You $350,000*. Independent Publisher.

[23] Smith, R., & Jones, M. (2024). *Prompt Engineering and Generative AI Applications for Teaching and Learning*. Academic Press.

[24] Coursera. (2024). Prompt Engineering Courses.

https://www.coursera.org/courses?query=prompt+engineering
[25] Simplilearn. (2025). Professional Certificate Program in Generative AI and Machine Learning - IIT Guwahati. https://www.simplilearn.com/iitg-generative-ai-machine-learning-program

Introduction to DBMS (OE)			
Course Code	**23CDO641**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Learning objectives:

1. Understand the basics of database concepts, technology, and practice.
2. Gain Knowledge of the relational database design principles.
3. Practice SQL programming through a variety of database.
4. Learn the use of concurrency and transactions in database.
5. Gain knowledge of building database applications for real world problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach.

Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.

08 Hours

Module – II

Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams.

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

08 Hours

Module – III

SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Implementation of different types of Joins in SQL, Views in SQL.

08 Hours

Module – IV

Functional Dependencies and Normalization: Informal design guidelines for relation schemas, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms,

Boyce-Codd Normal Form., Multivalued dependency and Fourth Normal Form, Join dependency and Fifth Normal form. **08 Hours**

Module – V

Transaction Processing Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions. Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

08 Hours

Teaching-Learning Process for all modules	Chalk and talk method / PowerPoint Presentation

Course Outcomes:
On completion of this course,

CO1: Students will be able to explain basic database concepts, DBMS advantages, data models, schemas, and database architecture.

CO2: Students will be able to design ER models and apply relational model concepts, constraints, and update operations in relational databases.

CO3: Students will be able to write SQL queries to define, manipulate, and retrieve data using constraints, joins, views, and advanced SQL features.

CO4: Students will be able to analyze functional dependencies and normalize relational schemas up to Fifth Normal Form.

CO5: Students will be able to explain transaction processing concepts, ACID properties, schedule characteristics, and transaction support in SQL.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.

Reference Books:

1. An Introduction to Database Systems, C. J. Date, A. Kannan and S. Swamynathan, Pearson Education, Eighth Edition, 2009.
2. Database System Concepts, Abraham Silberschatz, Henry F. Korth and S. Sudarshan, McGraw-Hill Education (Asia), Fifth Edition, 2006.

Web links and Video Lectures (e-Resources):

1. https://www.javatpoint.com/dbms-tutorial
2. Introduction to Database Management Systems (youtube.com) by Neso Academy

FUNDAMENTALS OF OPERATING SYSTEMS (OE)			
Course Code	**23CDO642**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. To demonstrate the need and different types of OS.
2. To discuss suitable techniques for management of different resources
3. To analyse different memory, storage, and file system management strategies.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction: What operating systems do; Computer System organization; Computer System Organization, Computer System architecture; Operating System operations; Resource Management

Operating System Structures: Operating System Servies, User and Operating System interface; System calls, Application Program Interface, Types of system calls.

Textbook 1: Chapter 1: 1.1, 1.2, 1.3,1.4, 1.5 Chapter 2: 2.1, 2.2 (2.2.1, 2.2.2), 2.3 (2.3.2, 2.3.3)

08 Hours

Module – II

Process Management: Process concept; Process scheduling; Operations on processes; Interprocess Communication

Multi-threaded Programming: Overview; Multithreading models, Thread Libraries

Textbook 1: Chapter 3: 3.1-3.4, Chapter 4: 4.1, 4.3 5, 4.4 **08 Hours**

Module – III

CPU Scheduling: Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling**.**

Process Synchronization: Synchronization: The critical section problem; Peterson’s solution; Semaphores; Classical problems of synchronization;

Textbook 1: Chapter 5: 5.1, 5.2,5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4 Chapter 6: 6.1, 6.2.,6.3, 6.6 **08 Hours**

Module – IV

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Memory Management: Background; Contiguous memory allocation; Paging; Structure of page table.

Textbook 1: Chapter 8: 8.1-8.8 Textbook 1: Chapter 9: 9.1-9.4 (9.4.1, 9.4.2) **08 Hours**

Module – V

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement.
File System Interface: File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations,
File System Internals: File Systems, File System Mounting; Partition and Mounting, File sharing;
Textbook 1: Chapter 10: 10.1-10.3, 10.4 (10.4.1, 10.4.2, 10.4.4.) Chapter 13: 13.1, 13.2, 13.3 (13.3.1, 13.3.2, 13.3.3), 13.4 (13.4.1, 13.4.2) Chapter 15: 15.1-15.4 **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to :

CO1: Explain the fundamentals of operating systems.
CO2: Apply appropriate CPU scheduling algorithm for the given scenarios.
CO3: Analyse the various techniques for process synchronization and deadlock handling.
CO4: Apply the various techniques for memory management.
CO5: Analyse the importance of File System Mounting and File Sharing.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 10th edition, Wiley-India, 2015.

Reference Books:

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition, 2010.
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013, P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
3. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson, 2008.

1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019.
2. T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems",Kluwer Academic Publishers.

Web links and Video Lectures (e-Resources):

1.https://archive.nptel.ac.in/courses/106/105/106105214/
2.https://archive.nptel.ac.in/courses/106/102/106102132/

MOBILE APPLICATION DEVELOPMENT (OE)

Course Code	**23CDO643**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. Create, test and debug Android application by setting up Android development environment.
2. Implement adaptive, responsive user interfaces that work across a wide range of devices.
3. Infer long running tasks and background work in Android applications
4. Demonstrate methods in storing, sharing and retrieving data in Android applications.
5. Analyze performance of android applications
6. Describe the steps involved in publishing Android application to share with the world.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Introduction to Android OS: Android Description – Open Handset Alliance – Android. Ecosystem – Android versions – Android Activity – Features of Android – Android Architecture Stack Linux Kernel. Configuration of Android Environment: Operating System – Java JDK Android SDK – Android Development Tools (ADT) – Android Virtual Devices (AVDs) – Emulators Dalvik Virtual Machine – Differences between JVM and DVM – Steps to Install and Configure Eclipse and SDK.
(Chapters 1 & 2) **08 Hours**

Module – II

Create the first android application: Directory Structure. Android User Interface: Understanding the Components of a screen‑ Linear Layout ‑ Absolute Layout ‑ Frame. Layout Relative Layout ‑ Table Layout.
(Chapters 3 & 4) **08 Hours**

Module – III

Designing User Interface with View ‑ Text View ‑ Button ‑ Image Button ‑ Edit Text Check Box ‑ Toggle Button ‑ Radio Button and Radio Group ‑ Progress Bar ‑ Auto complete Text View ‑ Spinner ‑ List View ‑ Grid View ‑ Image View - Scroll View ‑ Custom Toast ‑ Alert ‑ Time and Date Picker.
(Chapter 5) **08 Hours**

Module – IV

Activity: Introduction ‑ Intent ‑ Intent filter ‑ Activity life cycle ‑ Broadcast life cycle Service. Multimedia: Android System Architecture ‑ Play Audio and Video ‑ Text to Speech.
(Chapters 6 & 7) **08 Hours**

Module – V

SQLite Database in Android: SQLite Database – Creation and Connection of the database – Transactions. Case Study: SMS Telephony and Location Based Services.
(Chapters 8, 9, & 10) **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to:

CO1: Explain Mobile Application Ecosystem like concepts, architecture, and lifecycle of mobile applications on Android.

CO2: Identify the key components of mobile application frameworks and development tools.

CO3: Apply design principles to create intuitive and responsive user interfaces using appropriate UI/UX tools.

CO4: Develop Functional Mobile Applications -Integrate core functionalities such as layouts, event handling, navigation, and multimedia support into applications.

CO5: Implement local data storage mechanisms (SQLite, Shared Preferences) and external databases (Firebase, APIs) for mobile applications.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. Prasanna Kumar Dixit, "Android", Vikas Publishing House Private Ltd., Noida, 2014.

Reference Books:

1. Reto Meier and Wrox Wiley, “Professional Android 4 Application Development”, 2012.
2. ZiguradMednieks, LaridDornin, G.BlakeMeike, Masumi Nakamura, “Programming Andriod”, O’Reilly,2013.
3. Robert Green, Mario Zechner, “Beginning Android 4 Games Development”, Apress Media LLC, New York, 2011.

Web links and Video Lectures (e-Resources):

1. https://www.geeksforgeeks.org/android-tutorial/
2. https://developer.android.com/
3. https://www.tutorialspoint.com/android
4. https://www.w3schools.blog/android-tutorial

INTRODUCTION TO DATA STRUCTURES (OE)

Course Code	**23CDO644**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**3:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

1. Introduce primitive and non-primitive data structures
2. Understand the various types of data structure along their operations
3. Study various searching and sorting algorithms
4. Assess appropriate data structures during program development / problem solving

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students‟ Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – I

Arrays: Introduction, One-Dimensional Arrays, Two-Dimensional Arrays, Initializing Two-Dimensional Arrays, Multidimensional arrays.

Pointers: Introduction, Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions.

Structures and Unions: Introduction, Declaring Structures, Giving Values to Members, Structure Initialization, Comparison of Structure Variables, Arrays of Structures, Arrays within Structures, Nested Structures, Unions, Size of Structures.

Textbook 1: Ch. 8.1 to 8.5, Ch. 12.1 to 12.8, 12.10, 12.11.

Textbook 2: Ch. 2.1 to 2.3, 2.5, 2.9. **08 Hours**

Module – II

Stacks: Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks.

Queues: Introduction, Queue Operations, Queue Implementation using Arrays, Different Types of Queues: Circular Queues, Double-Ended Queues, Priority Queues, Applications of Queues.

Textbook 2: Ch. 6.1 to 6.3, Ch. 8.1 to 8.2. **08 Hours**

Module – III

Linked Lists: Introduction, Singly Linked List, Self-Referential Structures, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List, Concatenate two Lists, Reverse a List without Creating a New Node, Static Allocation Vs Linked Allocation.

Circular Singly Linked List: Introduction, Operations: Insert-Delete-Display.

Textbook 2: Ch. 9.1 to 9.2, 9.3 (Only 9.3.1 to 9.3.5, 9.3.11 to 9.3.12), 9.4 to 9.5. **08 Hours**

Module – IV

Trees: Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees.
Textbook 2: Ch. 10.1 to 10.4, 10.5 (Only 10.5.1, 10.5.2, 10.5.3.1, 10.5.3.2, 10.5.3.4), 10.6.3. **08 Hours**

Module – V

Sorting: Introduction, Bubble Sort, Selection Sort, Insertion Sort.
Searching: Introduction, Linear Search, Binary Search.
Textbook 1: Ch. 17.1, 17.2.6, 17.3.2.
Textbook 2: Ch. 11.1 to 11.3, 11.10.1. **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Active Learning, PPT Based presentation, Video

Course Outcomes

At the end of the course, the student will be able to :

CO1: Develop C programs utilizing fundamental concepts such as arrays, pointers and structures.
CO2: Apply data structures like stacks and queues to solve problems.
CO3: Develop C programs using linked lists and their various types.
CO4: Explain the fundamental concepts of trees and their practical applications.
CO5: Demonstrate different sorting and searching algorithms and determine their algorithmic complexities.

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Suggested Learning Resources:

Text Books:

1. E Balagurusamy, "C Programming and Data Structures", 4th Edition, McGraw-Hill, 2007.
2. A M Padma Reddy, "Systematic Approach to Data Structures using C", 9th Revised Edition, Sri Nandi Publications, 2009.

Reference Books:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2014.
2. Seymour Lipschutz, "Data Structures Schaum's Outlines", Revised 1st Edition, McGraw-Hill, 2014.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=DFpWCl_49i0
2. https://www.youtube.com/watch?v=x7t_-ULoAZM
3. https://www.youtube.com/watch?v=I37kGX-nZEI
4. https://www.youtube.com/watch?v=XuCbpw6Bj1U
5. https://www.youtube.com/watch?v=R9PTBwOzceo
6. https://www.youtube.com/watch?v=qH6yxkw0u78
7. https://archive.nptel.ac.in/courses/106/105/106105085/
8. https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

MACHINE LEARNING LAB

Course Code	**23CDL66**	**CIE Marks**	**50**
Teaching Hours /Week(L:T:P)	**(0:0:2)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**12 Lab slots**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course objectives:

As a student will be able to:

1. To become familiar with data and visualize univariate, bivariate, and multivariate data using statistical techniques and dimensionality reduction.
2. To understand various machine learning algorithms such as similarity-based learning, regression, decision trees, and clustering.
3. To familiarize with learning theories, probability-based models and developing the skills required for decision-making in dynamic environments.

LIST OF LABORATORY PROGRAMS – PART A

1.	Develop a program to create histograms for all numerical features and analyze the distribution of each feature. Generate box plots for all numerical features and identify any outliers. Use California Housing dataset. **Book 1: Chapter 2**
2.	Develop a program to Compute the correlation matrix to understand the relationships between pairs of features. Visualize the correlation matrix using a heatmap to know which variables have strong positive/negative correlations. Create a pair plot to visualize pairwise relationships between features. Use California Housing dataset. **Book 1: Chapter 2**
3.	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2. **Book 1: Chapter 2**
4.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples. **Book 1: Chapter 3**
5.	Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of [0,1]. Perform the following based on dataset generated. 1. Label the first 50 points $\{x_1,\ldots\ldots,x_{50}\}$ as follows: if $(xi \leq 0.5)$, then $x_i \in$ Class1, else $x_i \in$ Class1 2. Classify the remaining points, $x_{51},\ldots\ldots,x_{100}$ using KNN. Perform this for $k=1,2,3,4,5,20,30$ **Book 2: Chapter – 2**
6.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. **Book 1: Chapter – 4**
7.	Develop a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression. **Book 1: Chapter – 5**
8.	Develop a program to demonstrate the working of the decision tree algorithm. Use Breast Cancer Data set for building the decision tree and apply this knowledge to classify a new sample. **Book 2: Chapter – 3**
9.	Develop a program to implement the Naive Bayesian classifier considering Olivetti Face Data set for training. Compute the accuracy of the classifier, considering a few test data sets. **Book 2: Chapter – 4**
10.	Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result. **Book 2: Chapter – 4**

Case Study- PART B

1. **IBM Watson in Healthcare:** How AI assists doctors in diagnosing diseases.
2. **Netflix Recommendation System:** How ML personalizes movie recommendations.
3. **Facebook Friend Recommendation System:** How clustering is used to suggest friends.
4. **Google DeepMind's AlphaGo:** How AI mastered the game of Go.
5. **AI in Criminal Justice:** Examining how AI is used in predictive policing and the ethical concerns involved

Course Outcomes:

At the end of the course the student will be able to :

CO1: Illustrate the principles of multivariate data and apply dimensionality reduction techniques.

CO2: Demonstrate similarity-based learning methods and perform regression analysis.

CO3: Develop decision trees for classification and regression problems, and Bayesian models for probabilistic learning.

CO4: Implement the clustering algorithms to share computing resources.

Text Books:

1. S Sridhar and M Vijayalakshmi, "Machine Learning", Oxford University Press, 2021.
2. M N Murty and Ananthanarayana V S, "Machine Learning: Theory and Practice", Universities Press (India) Pvt. Limited, 2024.

Web links and Video Lectures (e-Resources):

1. https://www.drssridhar.com/?page_id=1053
2. https://www.universitiespress.com/resources?id=9789393330697
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Assessment Details(both IAT and SEE)

Continuous Internal Assessment of Laboratory/Practical Courses		
Lab Test 1	Lab Test 2	Lab Records
15 marks	15 marks	20 marks
Semester End Examination(SEE)		50 marks

Conduct of Practical Examination:

Experiment distribution :

For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.

For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and case study presentation from PART B, with equal opportunity.

- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution (Need to change in accordance with university regulations)

a) For laboratories having only one part → Procedure + Execution + Viva-Voce:
15+70+15 = 100 Marks

b) For laboratories having PART A and PART B

i. Part A – Procedure + Execution + Viva =10 + 30 + 10 =50 Marks

ii. Part B – Report + Presentation + Viva = 10 + 30 + 10 = 50 Marks

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	3	0	0	1	2	1	2	3	3	1
CO2	3	3	2	3	3	0	0	1	2	1	2	3	3	2
CO3	3	3	2	3	3	0	0	2	2	1	2	3	3	2
CO4	2	3	3	3	3	0	0	2	2	1	2	3	3	2

AWS			
Course Code	**23CDT671**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic computer usage and familiarity with the Internet
- Understanding of fundamental IT concepts
- Logical thinking and interest in cloud technologies

Course Objectives:

Students will be able to:

- Understand the fundamental concepts of cloud computing, AWS services, cloud economics, and billing models.
- Gain Knowledge of security principles, identity management, and compliance practices in the AWS cloud environment.
- Acquire conceptual skills of core AWS networking, compute, and application services to design basic cloud solutions.
- Understand how to identify and utilize appropriate AWS storage and database services based on application requirements.
- Gain knowledge of scalable, cost-optimized, and monitored cloud architectures using AWS best practices.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Cloud Computing & AWS Overview: Introduction to Cloud Computing, Advantages of Cloud Computing, Introduction to Amazon Web Services (AWS), AWS Cloud Adoption Framework (AWS CAF), Cloud Economics and Billing Fundamentals, Total Cost of Ownership, AWS Organizations, AWS Billing and Cost Management.

03 Hours

Module – II

AWS Security & Identity: AWS Global Infrastructure Overview, AWS Shared Responsibility Model, Identity and Access Management (IAM), Securing AWS Accounts and Data, Compliance Overview, Additional Security Services.

03 Hours

Module – III

Networking & Compute Services: Networking Basics, Amazon Virtual Private Cloud (VPC), VPC Security, Amazon Route 53, Amazon CloudFront, Amazon EC2 Overview and Cost Optimization, Introduction to Container Services, AWS Lambda, AWS Elastic Beanstalk.

03 Hours

Module – IV

Storage & Databases: Amazon Simple Storage Service (S3), Amazon Elastic Block Store (EBS), Amazon Elastic File System (EFS), Amazon S3 Glacier, Amazon RDS, Amazon DynamoDB, Amazon Redshift, Amazon Aurora.

02 Hours

Module – V

Cloud Architecture, Auto Scaling & Monitoring: Cloud Architecture Overview, Auto Scaling, Monitoring with Amazon CloudWatch, Cost and Performance Optimization, Best Practices.

02 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

CO1: Explain the fundamental concepts of cloud computing, AWS services, cloud economics, and billing models.

CO2: Apply security principles, identity management, and compliance practices in the AWS cloud environment.

CO3: Analyze and use core AWS networking, compute, and application services to design basic cloud solutions.

CO4: Identify and utilize appropriate AWS storage and database services based on application requirements.

CO5: Design and evaluate scalable, cost-optimized, and monitored cloud architectures using AWS best practices.

Textbooks:

1. **AWS Certified Solutions Architect Official Study Guide: Associate Exam** – Joe Baron, Hisham Baz, Tim Bixler, Biff Gaut, Kevin E. Kelly
2. **Amazon Web Services in Action** – Michael Wittig & Andreas Wittig
3. **Learning Amazon Web Services (AWS)** – Mark Wilkins
4. **AWS: The Definitive Guide** – Joyce Kay Avila (O'Reilly)

Reference Books:

1. **AWS Certified Solutions Architect Official Study Guide: Associate Exam** – Joe Baron et al.
2. **AWS: The Definitive Guide** – Joyce Kay Avila (O'Reilly)
3. **Learning Amazon Web Services (AWS)** – Mark Wilkins
4. **Amazon Web Services in Action** – Michael Wittig & Andreas Wittig

E-Resources:

1. **AWS Training & Certification (Official):** **https://aws.amazon.com/training/**
2. **AWS Documentation & Tutorials:** **https://docs.aws.amazon.com/**
3. **Free Hands-on Labs:** **https://aws.amazon.com/getting-started/hands-on/**
4. **AWS Cloud Practitioner Essentials (Free Online Course):** **https://www.aws.training/Details/Curriculum?id=20685**

CO-PO MAPPING

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

APPLICATION DEVELOPMENT USING REACT AND REACT NATIVE

Course Code	**23CDT672**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic computer usage and familiarity with web browsing
- Basic understanding of programming concepts is desirable but not mandatory

Course Objectives:

Students will be able to:

- Understand way of writing **clean and efficient JavaScript code** using modern ES6+ features.
- Gain knowledge of **responsive frontend applications** using React components and hooks.
- Acquire skills to design and implement **RESTful APIs** using Node.js and Express.
- Understand integrating **MongoDB databases** with backend applications using Mongoose.
- Learn how build and deploy a **basic full-stack MERN application** following industry best practices.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

JavaScript Core Fundamentals: Introduction to JavaScript and execution environment, Variables, data types, operators, Control statements and loops, Functions and arrow functions, Arrays and array methods, Objects and object methods, DOM manipulation and events, Browser storage and debugging.

03 Hours

Module – II

Advanced JavaScript & ES6+: Scope, hoisting, closures, Callbacks, Promises, async/await, Error handling, ES6 features, Modules and JSON, Fetch API and Axios, NPM basics.

02 Hours

Module – III

Frontend with React: React basics and JSX, Components, Props and State, Hooks (useState, useEffect), Forms and Routing, API Integration, Styling approaches using React.

03 Hours

Module – IV

Backend with Node & Express: Node.js architecture, Express framework, Routing and Middleware, REST APIs, CRUD operations, JWT Authentication basics, Postman testing.

02 Hours

Module – V

MongoDB & Full MERN Stack: MongoDB basics, Mongoose schemas and models, Database integration, Full MERN stack flow, Authentication flow, Deployment basics

03 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

- Write and Explain **clean and efficient JavaScript code** using modern ES6+ features.
- Apply Logical skills to develop **responsive frontend applications** using React components and hooks.
- Design and implement **RESTful APIs** using Node.js and Express.
- Integrate **MongoDB databases** with backend applications using Mongoose.
- Build and deploy a **basic full-stack MERN application** following industry best practices.

Textbooks:

1. **Eloquent JavaScript** – *Marijn Haverbeke*
2. **Learning React** – *Alex Banks & Eve Porcello*
3. **Node.js Design Patterns** – *Mario Casciaro & Luciano Mammino*

Reference Books:

1. **JavaScript: The Definitive Guide** – *David Flanagan*
2. **Full-Stack React Projects** – *Shama Hoque*
3. **MongoDB: The Definitive Guide** – *Kristina Chodorow*

E-Resources:

1. **JavaScript (MDN Web Docs):** **https://developer.mozilla.org/en-US/docs/Web/JavaScript**
2. **React Official Documentation:** **https://react.dev/**
3. **Node.js Official Documentation:** **https://nodejs.org/en/docs**
4. **Express.js Documentation:** **https://expressjs.com/**
5. **MongoDB Official Documentation:** **https://www.mongodb.com/docs/**

CO-PO MAPPING

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

CYBER SECURITY			
Course Code	**23CDT673**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

Good knowledge of Networking and Operating Systems.

Course Objectives:

Students will be able to:

- Understand the fundamental concepts, principles, and terminology related to cyber security and ethical hacking.
- Gain Knowledge of information security scenarios using appropriate tools and techniques to identify potential threats and vulnerabilities.
- Acquire knowledge of ethical hacking methodologies and security practices to assess systems, networks, and applications.
- Understand industry-relevant tools and techniques for information gathering, analysis, and security assessment in a controlled and ethical manner.
- Gain skills of demonstrating professional ethics, legal compliance, and effective reporting skills while performing cyber security and penetration testing activities.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Introduction to Ethical Hacking: Introduction to Ethical Hacking, Introduction to Cyber Security and its foundation.

02 Hours

Module – II

Reconnaisance and Enumeration: Introduction, Techniques and Tools, Cryptography fundamentals.

03 Hours

Module – III

Attacks and Vulnerabilities: Vulnerability Scanning and Analysis, Web and Application attacks.

03 Hours

Module – IV

Exploitation and Social Engineering: Introduction to Social Engineering and OSINT, Installing and Registering Maltego, Information Gathering with Maltego,

02 Hours

Module – V

Pentesting and Reporting: Wireless penetration testing, Reporting and Ethics.

03 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The Student will be able to:

CO1: Explain the fundamental concepts, principles, and terminology related to cyber security and ethical hacking.

CO2: Apply ethical hacking methodologies and security practices to assess systems, networks, and applications.

CO3: Analyze information security scenarios using appropriate tools and techniques to identify potential threats and vulnerabilities.

CO4: Use industry-relevant tools and techniques for information gathering, analysis, and security assessment in a controlled and ethical manner.

CO5: Demonstrate professional ethics, legal compliance, and effective reporting skills while performing cyber security and penetration testing activities.

Text Books:

1. Penetration Testing: A Hands-On Introduction to Hacking, Georgia Weidman,No Starch Press, USA, 1st Edition,2014.

Reference Books:

1. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, Wiley Publishing, 2nd Edition, 2011.

E-Resources:

1. https://mile2.com/m2-courses/cpeh/version-00/labguides/index.html

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
CO2	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
AVG	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**-**	**-**

SALESFORCE			
Course Code	**23CDT674**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic computer usage and familiarity with web applications
- Understanding of basic business processes (sales or customer support) is desirable
- No prior Salesforce experience required

Course Objectives:

Students will be able to:

- Understand **Salesforce platform architecture, CRM concepts, and data models**.
- learn to Configure **users, profiles, permissions, and data access controls** securely.
- Gain knowledge of **Sales and Service Cloud features** and understand deployment basics and Admin certification requirements.
- Acquire skills of implementing **automation using workflows, flows, and approval processes**.
- Lear hoe to design **customized Lightning interfaces, reports, and dashboards** for business insights.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Salesforce Fundamentals & Data Modeling: CRM concepts, Salesforce ecosystem and editions, Lightning Experience navigation, standard and custom objects, fields and field types, relationships (lookup & master-detail), schema builder, validation rules.

03 Hours

Module – II

Data Management & Security Administration: User management and licenses, profiles, roles, permission sets, object-level, field-level and record-level security, organization-wide defaults, sharing rules, data import wizard, data loader.

03 Hours

Module – III

Automation & Business Process Management: Workflow rules, Process Builder, Flow Builder (record-triggered flows), approval processes, email alerts, automation best practices, real-time business use cases.

02 Hours

Module – IV

Salesforce UI Customization & Analytics: Page layouts, Lightning App Builder, compact layouts, mobile customization, report types, tabular/summary/matrix reports, dashboards, folders and sharing.

02 Hours

Module – V

Sales & Service Cloud + Deployment & Certification: Leads, accounts, contacts, opportunities, sales process, cases, queues, assignment rules, email-to-case, service console, sandbox types, change sets, deployment basics, Admin certification overview and exam readiness.

03 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

- Explain **Salesforce platform architecture, CRM concepts, and data models**.
- Configure **users, profiles, permissions, and data access controls** securely.
- Apply **Sales and Service Cloud features** and understand deployment basics and Admin certification requirements.
- Implement **automation using workflows, flows, and approval processes**.
- Design **customized Lightning interfaces, reports, and dashboards** for business insights.

Textbooks:

1. **Salesforce Certified Administrator Official Study Guide** – *Mike Wheeler*
2. **Learning Salesforce Lightning Application Development** – *Alessandro Benedetti*

Reference Books:

1. **Salesforce Platform Developer I Certification Guide** – *Raghavendra Dixit*
2. **Practical Salesforce Development Without Code** – *Davor Miljanović*

E-Resources:

1. **Salesforce Trailhead (Official Learning Platform): https://trailhead.salesforce.com**
2. **Salesforce Help & Training Documentation: https://help.salesforce.com**
3. **Salesforce Admin Certification Overview: https://trailhead.salesforce.com/credentials/administrator**
4. **Salesforce Object & Data Modeling Documentation: https://developer.salesforce.com/docs**
5. **Salesforce Automation (Flow Builder) Guide: https://help.salesforce.com/s/articleView?id=sf.flow.htm**

CO-PO MAPPING

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

DATA ANALYTICS

Course Code	**23CDT675**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic computer usage skills and familiarity with spreadsheets
- Understanding of simple mathematics and logical thinking

Course Objectives:

Students will be able to:

- Understand the need for data and its attributes using industry-standard analytical tools.
- Gain Knowledge of data querying and manipulation techniques to extract meaningful insights from structured data.
- Acquire knowledge of preparing interactive reports and dashboards for effective decision-making.
- Understand automation techniques to streamline data reporting and notification processes.
- Gain knowledge of end-to-end data analytics workflow, including cloud-based data storage and processing concepts.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Excel for Data Analysis: Introduction to Excel, Data formatting and customization, Basic formulas and functions, Sorting, filtering and conditional formatting, Charts overview.

03 Hours

Module – II

SQL for Data Retrieval and Analysis: SQL basics, Data retrieval using SELECT and WHERE, Aggregation and GROUP BY, Joins (INNER, LEFT), Subqueries and CTEs (intro), Data manipulation (INSERT, UPDATE, DELETE).

03 Hours

Module – III

Power BI Fundamentals: Power BI interface and navigation, Data connection and preparation, Data modeling and relationships, Basic DAX functions, Report design and visualizations**.**

04 Hours

Module – IV

Power BI Automation: Introduction to Power BI Service, Publishing reports and dashboards, Power Automate integration, Creating buttons and triggers, Email and Teams notifications.

02 Hours

Module – V

Snowflake Technical Foundations: Snowflake overview and architecture, Connecting to Snowflake, SQL support and querying, Virtual warehouse scaling, Data loading and access control basics

01 Hour

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

- Explain the need for data and its attributes using industry-standard analytical tools.
- Apply data querying and manipulation techniques to extract meaningful insights from structured data.
- Design and present interactive reports and dashboards for effective decision-making.
- Develop automation techniques to streamline data reporting and notification processes.
- Demonstrate end-to-end data analytics workflow, including cloud-based data storage and processing concepts.

Textbooks:

1. Data Analysis with Microsoft Excel – *K. Berk & Patrick Carey*
A practical, beginner-friendly guide to Excel for data analysis, data formatting, functions, and visualization.

2. Learning SQL (4th Edition) – *Alan Beaulieu*
A clear, up-to-date textbook on SQL fundamentals, data querying, and database interaction ideal for analytics learners.

3. Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics – *Dan Clark*
Comprehensive and hands-on introduction to Power BI, covering connecting data, creating reports, and dashboards.

Reference Books:

1. **Data Analysis Using SQL and Excel** – *Gordon S. Linoff & Daniel T. Norton*
   A practical guide showing how SQL and Excel together support business data analysis workflows.
2. **Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics** – *Dan Clark*
   Well-structured for beginners in Power BI, covering data import, modeling, visuals, and dashboards.
3. **The Definitive Guide to DAX: Business Intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel** – *Marco Russo & Alberto Ferrari*
   A comprehensive reference for understanding and applying DAX for advanced analytics in Power BI.
4. **Snowflake: The Definitive Guide** – *Joyce Kay Avila (O'Reilly)*
   Authoritative book on Snowflake architecture, querying, and cloud data warehousing concepts.

E-Resources:

1. **Free Excel tutorial — GeeksforGeeks:** **https://www.geeksforgeeks.org/excel-tutorial/**
2. **Free practice exercises for Excel, SQL, Power BI (Wise Owl):** **https://www.wiseowl.co.uk/exercises/**
3. **Power BI: Get Data (Microsoft Learn training) — official module covering connecting Excel and databases, import data, etc.:** **https://learn.microsoft.com/en-in/training/modules/get-data/**
4. **Snowflake official tutorials (SQL, loading data, basics) — Snowflake Documentation:** **https://docs.snowflake.com/en/learn-tutorials**
5. **End-to-End Analytics with Snowflake + Power BI (guide) — Snowflake Developers Guide:** **https://www.snowflake.com/en/developers/guides/end-to-end-analytics-with-snowflake-and-power-bi/**

CO-PO MAPPING

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

ServiceNow			
Course Code	**23CDT676**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic computer usage and familiarity with web applications
- Understanding of basic IT service concepts is desirable but not mandatory
- No prior ServiceNow experience required

Course Objectives:

Students will be able to:

- Learn **ServiceNow platform features, navigation, and instance configuration**.
- Understand how to Configure and manage **core ITSM processes** such as Incident, Change, and Problem Management.
- Gain knowledge of **self-service solutions and workflow automation** using Flow Designer and Service Catalog.
- Acquire knowledge of **ServiceNow development concepts** using Glide APIs and UI Actions.
- Learn **basic scripts, access controls, and scheduled jobs** following best practices.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Platform Overview and Navigation: ServiceNow platform overview, platform capabilities and services, ServiceNow instance and architecture, Next Experience Unified Navigation, installing applications and plugins, personalizing and customizing the instance, common user interfaces.

02 Hours

Module – II

Application Configuration & ITSM Processes: Lists, filters, and tags, form configuration, Incident Management, Change Management, Problem Management, notifications, reporting and dashboards.

03 Hours

Module – III

Self-Service & Automation: Knowledge Management, Service Catalog, Flow Designer, importing data, UI Policies, system update sets.

03 Hours

Module – IV

ServiceNow Development Fundamentals:: Introduction to ServiceNow scripting and development, Glide API overview, GlideRecord, GlideForm, GlideUser, UI Actions.

02 Hours

Module – V

Advanced Scripting & Security: Client Scripts, Business Rules, Script Includes, Scheduled Jobs, Access Control Lists (ACLs), scripting best practices.

03 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

- Explain **ServiceNow platform features, navigation, and instance configuration**.
- Configure and manage **core ITSM processes** such as Incident, Change, and Problem Management.
- Apply **self-service solutions and workflow automation** using Flow Designer and Service Catalog.
- Aalyze **ServiceNow development concepts** using Glide APIs and UI Actions.
- Demonstrate **basic scripts, access controls, and scheduled jobs** following best practices.

Textbooks:

1. **Learning ServiceNow: Application Development and Administration** – *Tim Woodruff*
2. **ServiceNow Development Handbook** – *Mark Stanger*

Reference Books:

1. **ServiceNow System Administration – *Cory Thorne***
2. **Practical ServiceNow Development – *Peter Farrell***

E-Resources:

1. **ServiceNow Official Documentation: https://docs.servicenow.com**
2. **ServiceNow Now Learning (Official Training Platform): https://nowlearning.servicenow.com**
3. **ServiceNow Developer Portal: https://developer.servicenow.com**
4. **ServiceNow ITSM Documentation: https://docs.servicenow.com/bundle/tokyo-it-service-management/page/product/itsm/concept/c_ITServiceManagement.html**
5. **ServiceNow Flow Designer Guide: https://docs.servicenow.com/bundle/tokyo-servicenow-platform/page/administer/flow-designer/concept/flow-designer.html**

CO-PO MAPPING

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

GOOGLE FLUTTER

Course Code	**23CDT677**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**13**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

PREREQUISITES:

- Basic programming knowledge (variables, loops, functions)
- Familiarity with any object-oriented language (Java, C#, or Python) is helpful but not mandatory
- Basic computer skills and interest in mobile app development

Course Objectives:

- Provide a strong foundation in the fundamental concepts of Dart programming and Flutter application development.
- Understand how apply object-oriented programming principles and Dart language features for developing modular and reusable code.
- Gain knowledge of design and implementation of user interfaces using Flutter widgets, layouts, and Material Design principles.
- Introduce techniques for integrating application state management, external APIs, and backend services such as Firebase within Flutter applications.
- Acquire capability to build, deploy, and evaluate cross-platform mobile applications in accordance with industry best practices and standards.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem/Project Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

Module – I

Introduction to Dart: Basics of Dart (variables, data types, operators, keywords), Control Flow (if, else if, else, switch, loops: for, while, do-while, break, continue), Functions and Methods, Collections (List, Set, Map).

03 Hours

Module – II

Object-Oriented Programming in Dart: Classes and Objects, Inheritance, Encapsulation, Polymorphism, Abstraction, Static Variables and Methods, Enums, Mixins, Generics.

02 Hours

Module – III

Introduction to Flutter: Flutter Installation and Setup, Flutter Project Creation, Project Structure (folders and files), Widgets Overview (basic widgets, layout widgets, and styling).

02 Hours

Module – IV

Material Design & Navigation: Material Design Fundamentals (Scaffold, AppBar, Bottom Navigation Bar), UI Components (Buttons, Forms, Input Fields, SnackBar, Dialogs, Bottom Sheets), Theming and Styling (Colors, Typography, Dark/Light Mode, Custom Themes), State Management (setState, Provider).

03 Hours

Module – V

API Integration, Firebase & Deployment: API Integration in Flutter (HTTP package, JSON parsing,

Model Classes, Error Handling), Firebase Introduction and Services (Authentication and Storage), App Deployment (Generating APK/AAB, App Signing, Play Store and App Store Publishing, Post Deployment Updates and Versioning).

03 Hours

Assessment Details (both IAT and SEE)

Theory Component	IAT-1 after completion 45 to 50% Syllabus	25 Marks
	IAT-2 after completion 95 to 100% Syllabus	25 Marks
	Average of two IATs	**25 Marks**
	CCE-1	25 Marks
	CCE-2	25 Marks
	Average of two CCEs	**25 Marks**
Grand Total of IAT Marks (min marks 20 / 50)		**50 Marks**
SEE conducted for 100 and scaled down to 50 **(min marks 18/50)**		**50 Marks**
IAT + SEE (min marks 40)		**100 Marks**

Course outcomes:

The students will be able to:

CO1: Explain the fundamental concepts of Dart programming and Flutter application development.

CO2: Apply object-oriented programming principles and Dart language features to develop modular and reusable code.

CO3: Design and implement user interfaces using Flutter widgets, layouts, and Material Design principles.

CO4: Integrate and manage application state, external APIs, and backend services such as Firebase in Flutter applications.

CO5: Build, deploy, and evaluate cross-platform mobile applications following industry best practices and standards.

Textbooks:

1. **Programming Dart** – *Ivo Balbaert*
2. **Flutter in Action** – *Eric Windmill*
3. **Beginning Flutter: A Hands-On Guide to App Development** – *Marco L. Napoli*

Reference Books:

1. **Flutter Projects: A Practical, Project-Based Guide to Building Real-World Apps** – *Simone Alessandria*
2. **Dart Apprentice: Fundamentals** – *Jonathan Sande & Matt Galloway*
3. **Flutter Cookbook** – *Simone Alessandria & Alberto Miola*

E-Resources:

1. **Official Dart Documentation & Tutorials – https://dart.dev/guides**
2. **Flutter Official Documentation & Codelabs – https://flutter.dev/docs**
3. **Firebase for Flutter Documentation – https://firebase.google.com/docs/flutter/setup**
4. **Flutter YouTube Channel (Official Tutorials & Demos) – https://www.youtube.com/c/FlutterDev**
5. **Online Practice and Community – https://www.codewars.com/ (Dart exercises)**

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**
CO2	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**-**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
AVG	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**

INDIAN KNOWLEDGE SYSTEM (IKS)			
Course Code	**23IKS68**	**CIE Marks**	**100**
Teaching Hours/Week (L:T:P: S)	**1:0:0:0**	**SEE Marks**	**-**
Total Hours of Pedagogy	**20**	**Total Marks**	**100**
Credits	**0**	**Exam Hours**	**-**

Module – I

Introduction to Indian Knowledge System (IKS)

- Definition and Scope of IKS
- Importance of IKS in Modern Education
- Contributions of Ancient India to Science, Technology, and Arts
- IKS and Sustainable Development

Module – II

Science and Engineering in Ancient India

- Contributions of Indian Mathematicians (Aryabhata, Brahmagupta, Bhaskara)
- Astronomy and Timekeeping (Surya Siddhanta, Siddhantic Astronomy)
- Metallurgy and Civil Engineering (Iron Pillar, Stepwells, Vastu Shastra)
- Concepts of Fluid Mechanics, Materials Science, and Shipbuilding

Module – III

Ayurveda, Medicine, and Well-being

- Fundamentals of Ayurveda (Tridosha, Panchamahabhuta)
- Contributions of Charaka and Sushruta
- Yoga and its Scientific Basis (Patanjali Yoga Sutras)
- Siddha and Unani Medicine

Module – IV

Indian Philosophy, Ethics, and Governance

- Six Schools of Indian Philosophy (Nyaya, Vaisheshika, Samkhya, Yoga, Mimamsa, Vedanta)
- Dharma, Ethics, and Social Systems in Ancient India
- Arthashastra and Chanakya’s Contributions to Governance
- Justice Systems in Ancient India

Module – V

Linguistics, Literature, and Arts in IKS

- Evolution of Sanskrit and Other Indian Languages
- Classical Literature (Vedas, Upanishads, Mahabharata, Ramayana)
- Performing Arts (Natya Shastra, Bharatanatyam, Kathakali)

- Temple Architecture and Sculpture

Module – VI

Indian Knowledge and Modern Science

- Integration of IKS with Modern Science
- Influence of Indian Mathematics on the World (Decimal System, Zero, Algebra)
- Ancient Environmental Practices and Sustainability
- Relevance of IKS in Artificial Intelligence and Data Science

Suggested Learning Resources:

Suggested Textbooks & References

- "Science in Samskrit" – C.K. Raju
- "History of Indian Science and Technology" – D.P. Agrawal
- "Indian Knowledge System" – Kapil Kapoor