SIPNA COLLEGE OF ENGINEERING & TECHNOLOGY, AMRAVATI

An Autonomous Institute Affiliated to

Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

(Approved by AICTE, New Delhi and Recognized by DTE, Maharashtra)

(Accredited With 'A+' Grade by NAAC)

Bachelor of Technology (B. Tech.)

Syllabus - Semester V and Semester VI

Department of Computer Science and Engineering

B. Tech. Computer Science and Engineering

(Semester Pattern)

Effective from Academic Year 2026-27

Prepared by: Board of Studies - Computer Science and Engineering

Approved by: Academic Council - Sipna COET, Amravati

			30/03/2026	1.00
Chairman Board of Studies	Dean Academics	Chairman Academic Council	Date of Release	Version

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Theory of Computation			Code:			BTCSPC14CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To understand and design computational models such as finite automata, grammars, pushdown automata, and Turing machines for language recognition and decidability problems.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Identify the fundamentals of deterministic and non-deterministic finite automata for computational problem-solving.	L1
CO-2	Describe the structures and transformations of Moore machines, Mealy machines, regular expressions, and grammars.	L2
CO-3	Apply regular language properties and the pumping lemma for language recognition tasks.	L3
CO-4	Analyse context-free grammars, including derivation processes and grammar simplification techniques.	L4
CO-5	Evaluate pushdown automata and the fundamental properties of context-free languages.	L5
CO-6	Design Turing machines, distinguish decidable from undecidable problems, and determine computational limits.	L6

Unit I: Finite State Machines (6 Hrs.)

Alphabet, String, Definition and Types of FA, Definition and Design DFA (Deterministic Finite Automata), NFA (Non-Deterministic Finite Automata), Equivalence of NFA and DFA: Conversion of NFA into DFA, Conversion of NFA with epsilon moves to NFA, Minimization Of DFA, Minimization of Finite Automata

Unit II: Finite Automata with output and Regular Expression (6 Hrs.)

Definition and Construction of Moore and Mealy Machines, Inter-conversion between Moore and Mealy Machines. Definition and Identities of Regular Expressions, Construction of Regular Expression of the given Language, Construction of Language from the RE.

Unit III: Regular Language and Regular Grammar (6 Hrs.)

Conversion of FA to RE using Arden's Theorem, Inter-conversion RE to FA, Pumping Lemma for RL, Closure properties of RLs (proofs not required), Regular grammar, Equivalence of RG (RLG and LLG) and FA.

Unit IV: Context Free Grammar and Languages (6 Hrs.)

Introduction, Formal Definition of Grammar, Notations, Derivation Process: Leftmost Derivation, Rightmost Derivation, Derivation Trees, Construction of Context-Free Grammars and Languages, Pumping Lemma for CFL, Simplification of CFG, Normal Forms (CNF and GNF), Chomsky Hierarchy.

Unit V: Pushdown Automata **(6 Hrs.)**

Introduction and Definition of PDA, Construction of PDA, Acceptance of CFL, Equivalence of CFL and PDA: Inter-conversion, Introduction of DCFL and DPDA, Enumeration of properties of CFL, Context Sensitive Language, Linear Bounded Automata.

Unit VI: Turing Machines and Decidability and Un-Decidability **(6 Hrs.)**

Formal definition of a Turing Machine, Design of TM, Variants of Turing Machines: Multi-tape Turing machines, Universal Turing Machine. Decidability of Problems, Halting Problem of TM, Un-Decidability: Recursive enumerable language, Properties of recursive & non-recursive enumerable languages.

Total: 36 Hrs

Textbooks:

1. Hopcraft H.E. & Ullman J: Introduction to Automata Theory, Languages and Computation.
2. Peter Linz: An Introduction to Formal Languages and Automata.

Reference Books:

1. Rajesh K. Shukla: Theory of Computation, CENGAGE Learning, 2009.
2. K V N Sunitha and N Kalyani: Formal Languages and Automata Theory, McGraw Hill,2010
3. Lewis H.P. and Papadimition C.H.: Elements of Theory of Computation
4. Mishra & Chandrashekharan: Theory of Computation
5. C .K. Nagpal: Formal Languages and Automata Theory, Oxford University with removing some bulky content cycle Press, 2011.
6. Vivek Kulkarni : Theory of Computation, OUP India, 2013

MOOC Links:

1. NPTEL Course: Theory of Computation (By Prof. Subrahmanyam Kalyanasundaram | IIT Hyderabad)
   https://onlinecourses.nptel.ac.in/noc23_cs31/preview
2. Udemy Course: Theory of Computation (TOC) / Automata: Complete Pack
   https://www.udemy.com/course/theory-of-computation-automata-theory-for2021/?couponCode=CP251129CMG1

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Database Management System			Code:			BTCSPC15CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz.

Course Objectives: To provide fundamental knowledge of database systems, relational models, SQL, database design, transaction management, and advanced querying techniques for efficient data management.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand DBMS fundamentals, database architecture, data models, and ER diagrams with extended ER features.	L2
CO-2	Apply relational model concepts including schemas, keys, and relational algebra operations to formulate queries.	L3
CO-3	Construct SQL queries for data definition, manipulation for effective data retrieval and modification.	L6
CO-4	Evaluate normalization, functional dependencies, triggers, and query processing for efficient database design.	L5
CO-5	Analyze transaction concepts, serializability, and concurrency control to ensure atomicity, durability, and isolation in DBMS.	L4
CO-6	Apply SQL window functions for advanced analytical queries	L3

Unit I: Introduction to *DBMS* **(6 Hrs.)**

Database System Applications, View of Data, Database Languages, Database Architecture, Database Users and Administrators, Entity - Relationship Model, E-R diagrams, Extended E-R Features.

Unit II: Relational Model **(6 Hrs.)**

Structure of Relational Databases, Database schema, keys, schema diagram, relational query languages, The Relational Algebra, Fundamental operation of relational algebra.

Unit III: Structured Query Language **(6 Hrs.)**

Introduction to SQL, SQL data definition, Basic Structure of SQL queries, Queries on a single relation, Queries on multiple relations, Additional basic operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database, Integrity Constraints, Join, Views.

Unit IV: Relational Database Design and Query Processing **(6 Hrs.)**

Authorization, Triggers, Functional Dependency, Normalization,1NF,2NF, 3NF, BCNF, 4NF, Overview of Query processing, Measures of query cost.

Unit V: Transaction Management and Concurrency Control **(6 Hrs.)**

Transaction Concept, Simple transaction model, Transaction Atomicity and Durability, transaction isolation, Serializability, Lock-Based Protocols, Timestamp- Based Protocols.

Approved in 4th Academic Council Meeting
Dated:-30/03/2026

Unit VI: SQL Window Functions **(6 Hrs.)**

Introduction to Window Functions, Ranking Functions, Aggregate Window Functions, Value Window Functions, Window Frames & Advanced Concepts.

Total: 36 Hrs

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, DATABASE SYSTEM CONCEPTS, Sixth Edition, McGraw Hill.

Reference Books:

1. Rajesh Narang, "DATABASE MANGEMENT SYSTEMS", Eastern Economy Edition.
2. Pranab Kumar Das Gupta, "DATABASE MANGEMENT SYSTEMS ORACLE SQL AND PL/SQL",Eastern Economy Edition.

MOOC Links:

1. NPTEL Course: Data Base Management System (By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay | IIT Kharagpur)
https://onlinecourses.nptel.ac.in/noc26_cs39/preview

2. Udemy Course: Database Management System
https://www.udemy.com/course/database-management-system/?srsltid=AfmBOooiFtnmqETunRt7SFiIlcAhoqJqDpegejOCZtYWqymPDVaZHWaC

Approved in Academic Council Meeting
Dated:- 30/03/2026

Program:	B. Tech. (Computer Science and Engineering)			Semester:	V	
Course:	Database Management System Lab			Code:	BTCSPC16CS5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: Develop practical skills in designing and managing relational databases using SQL and E-R modelling tools.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Design conceptual and logical database models using data modelling tools for E-R diagrams.	L6
CO-2	Apply DDL commands to create, alter, and manage database schemas and constraints.	L3
CO-3	Execute DML commands (INSERT, UPDATE, DELETE, SELECT) and built-in SQL functions.	L3
CO-4	Analyze database using various clauses, joins, and nested queries.	L4
CO-5	Create views, stored procedure, and triggers for automation.	L4
CO-6	Develop a mini-project using relational (RDBMS) or non-relational databases (NoSQL)	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. Study of Data Modelling Tools (Tools used for creating E-R diagram like draw.io, Smart Draw, LucidChart, etc.).
2. Creation of database along with integrity constraints and inserting data into tables (University Database).
3. Study and implement DDL Commands (ALTER, DROP, TRUNCATE).
4. Write DML commands to perform the modifications to the database (UPDATE, DELETE).
5. Study and implement queries using SELECT, FROM, WHERE, WHERE clause predicates, String operations, Tuple variable.
6. Study and implement queries using Aggregate functions and various SQL clauses (GROUP BY, HAVING, ORDER BY).
4. Study and implement queries using SET OPERATIONS.
5. Study and implement Nested Subquery using SET MEMEBERSHIP, SET COMPARISON.
6. Study and implement joins. (inner and outer join)
7. Write SQL command to create Views.
8. Study and implement triggers.
9. Study Window SQL function.
10. Design a Mini Project.

11.Use built-in MySQL functions related to string and date functions.
12. Study and implement stored procedures in SQL.
13. Study and implement SQL CASE Expression.
14. Study and implement common table expression (WITH clause).
15. Study and implement self joins.
16. Study of Open-Source NoSQL Databases.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Computer Organization and Architecture			Code:			BTCSPC17CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To explain and apply core concepts of computer organization, including system structure, memory hierarchy, instruction execution, I/O mechanisms, arithmetic operations, and parallel and pipelined processor design.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the basic structure of a computer system, including buses, instruction formats, addressing modes, sequencing, and basic I/O.	L2
CO-2	Apply memory hierarchy concepts to analyze RAM/ROM technologies and trade-offs in speed, size, and cost.	L3
CO-3	Analyze instruction execution and compare hardwired and microprogrammed control units for performance.	L4
CO-4	Apply I/O organization methods such as interrupts and DMA for efficient CPU–device data transfer.	L3
CO-5	Evaluate computer arithmetic techniques including fast adders, multipliers, division, and floating-point operations.	L5
CO-6	Design parallel and pipelined processor architectures addressing speedup, throughput, and pipeline hazards.	L6

Unit I: Computer Structure and Microprocessor Basics: **(6 Hrs.)**

Basic operational concepts of computer system, introduction to microprocessor architecture and functions, memory locations and addresses (Big Endian, Little Endian), instruction format and sequencing, addressing modes, processor fundamentals, single bus organization, ALU operations.

Unit II: Processing Unit: **(6 Hrs.)**

Execution of a Complete Instruction, Hardwired Control, Performance Consideration, Microprogrammed Control, Microinstructions, Microprogram Sequencing.

Unit III: Memory Unit: **(6 Hrs.)**

Basic Concepts, Memory Hierarchy, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Dynamic Memories, Read Only Memories, Speed, Size and Cost.

Unit IV: I/O Organization and Microprocessor Interfacing: **(6 Hrs.)**

Accessing I/O devices in microprocessor-based systems, I/O interfacing techniques, interrupts and interrupt handling, enabling and disabling interrupts, handling multiple devices, DMA, I/O hardware, standard I/O interfaces (SCSI).

Unit V: Arithmetic: **(6 Hrs.)**

Number Representations, Design of Fast Adders, Signed Addition and Subtraction, Multiplication of Positive Numbers, Booth Multiplier, Integer Division, Arithmetic Operations on Floating point numbers, Guard Bit and Truncate Bit

Unit VI: Instruction Pipelining: **(6 Hrs.)**

Pipelining: Concept of instruction pipelining and motivation, Pipeline stages and basic pipeline organization, Throughput and speedup in pipelined processors, throughput and speedup, pipeline hazards

Total: 36 Hrs

Textbooks:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition Tata McGraw-Hill.

Reference Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. John P. Hayes, "Computer Architecture and Organization", McGraw Hill Publication.
3. DA Patterson and JLHennessy, Computer Organization and Design, Morgan Kaufmann Publisher, 2nd edition
4. A.S. Tanenbaum, "Structured Computer Organization", PHI Publication

MOOC Links:

1. NPTEL Course: Computer architecture and organization By Prof. Indranil Sengupta, Prof. Kamalika Datta | IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc21_cs61/preview
2. Coursera: Introduction to Computer Organization
   https://www.coursera.org/learn/introduction-to-computer-organization

Approved in..... Academic Council Meeting
Dated:-.....30/03/2026....

Program:	B. Tech. (Computer Science and Engineering)			Semester:	V	
Course:	Computer Skill Lab - V			Code:	BTCSPC18CS5P	
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To enable students to understand, implement, and evaluate DevOps tools and practices by applying Linux, Git, CI/CD pipelines, containerization, and cloud platforms for automated software development and deployment.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Describe Linux commands and the DevOps lifecycle.	L2
CO-2	Evaluate Git and GitHub workflows for effective version control.	L5
CO-3	Analyze branching strategies and implement CI using Jenkins.	L4
CO-4	Configure Jenkins automation jobs.	L3
CO-5	Create Docker containers and images.	L3
CO-6	Deploy cloud solutions using AWS and GCP resources.	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. Understand and demonstrate essential Linux commands required for DevOps operations.
2. Explain the DevOps lifecycle and identify the role of each phase in software delivery.
3. Install, configure, and initialize a local Git repository for version control.
4. Apply Git commands to push a local repository to GitHub.
5. Analyze Git branching strategies and differentiate between common branching models.
6. Install and configure Jenkins to support DevOps automation.
7. Create, execute, and manage Jenkins jobs for automated tasks.
8. *Implement Continuous Integration by integrating Git with Jenkins.*
9. Illustrate and evaluate the stages of a DevOps CI/CD pipeline.
10. Describe Google Cloud Platform services and explain their use in DevOps practices.
11. Create, run, and manage Docker containers for application deployment.
12. Demonstrate Docker Hub integration by pushing and pulling container images.
13. Create, configure, and access a Linux-based EC2 instance using the AWS Free Tier.
14. Create, configure, and access a Windows-based EC2 instance using Remote Desktop Protocol (RDP).
15. Design and develop a mini project by creating a GitHub repository and deploying project files to it.

Program:	**B. Tech. (Computer Science and Engineering)**			**Semester:**	**V**	
Course:	**Computer Skill Lab -VI**			**Code:**	**BTCSPC19CS5P**	
Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**0**	**2**	**1**	**30**	**20**	**50**

Course Objectives: To introduce students to the fundamental concepts, data types, and data structures of R programming for effective data analysis.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Understands R installation, environment setup, and basic commands.	L2
CO-2	Apply data types, data structures, and control statements to write R programs.	L3
CO-3	Perform data import, cleaning, preprocessing, and manipulation using R packages.	L4
CO-4	Construct effective visualizations using base R and ggplot2.	L6
CO-5	Analyze data using descriptive statistics and regression techniques.	L5
CO-6	Develop basic machine learning models, such as clustering in R and develop a mini data analysis project.	L6

General Guidelines: Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. Install R and RStudio. Explore the RStudio interface, console, script editor, and working directory.
2. *Write an R program to demonstrate basic data types (numeric, character, logical, vector operations).*
3. Create and manipulate vectors and matrices (indexing, slicing, arithmetic operations).
4. Implement lists and data frames (create, merge, subset, summarize).
5. Write R programs using control structures (if, else, switch).
6. Write R programs using loops (for, while, repeat) for numerical computations.
7. Create user-defined functions (factorial, Fibonacci, prime number check).
8. Create data frames and lists, access components, and perform CRUD operations.
9. Use string functions for concatenation, extraction, pattern matching, and replacement.
10. Conduct descriptive statistical analysis using any mean, median, sd, var, correlation.
11. Create bar plots, histograms, pie charts, boxplots, and line charts.
12. Use ggplot2 to plot scatter, boxplot, histogram, and faceted plots.
13. Build and evaluate simple linear regression
14. Perform dataset loading, cleaning, visualization, and model building on a real dataset.
15. Implement and visualize k-means clustering.

Approved in..... Academic Council Meeting
Dated:-.....26/03/2026...

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Program Elective Course-I Cryptography and Network Security			Code:			BTCSPE01CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To enable students to analyze security threats, evaluate countermeasures, and design secure network architectures using firewalls, IP security techniques, and integrated authentication mechanisms.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand fundamental concepts of cryptography and network security.	L2
CO-2	Learn classical and modern encryption techniques.	L1
CO-3	Evaluate the security features of symmetric and asymmetric encryption.	L5
CO-4	Understand secure communication protocols and email security.	L2
CO-5	Analyse security threats and countermeasures in networked environments.	L4
CO-6	Integrate authentication, firewall, and IP security concepts to design secure communication solutions	L3

Unit I: Cryptography: Concepts and Techniques **(6 Hrs.)**

The need for security, Principles of Security, Types of Attacks. Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks.

Unit II: Symmetric Key Algorithms and AES **(6 Hrs.)**

Algorithm Types and Modes, An overview of Symmetric Key Cryptography, DES, International Data Encryption Algorithm (IDEA), RC5, Blowfish, AES

Unit III: Asymmetric Key Algorithms and RSA **(6 Hrs.)**

Brief History of Asymmetric Key Cryptography, An overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm, Some other Algorithms.

Unit IV: Internet Security Protocols **(6 Hrs.)**

Internet Security Protocols: Basic Concepts, Secure Socket Layer, SHTTP, Time Stamping Protocol

Unit V: Network Security Protocols **(6 Hrs.)**

Secure Electronic Transaction, SSL versus SET, 3-D Secure Protocol, Electronic Money, E-mail Security, Wireless Application Protocol (WAP) Security, Security in GSM.

Unit VI: User Authentication and Kerberos **(6 Hrs.)**

Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication, Biometric Authentication, Kerberos, Key Distribution Centre (KDC), Firewalls, IP security.

Approved in 4th Academic Council Meeting
Dated:- 30/03/2026

Total: 36 Hrs

Textbooks:

1. Atul Kahate (2003), *Cryptography and Network Security*, 2nd Edition, Tata McGraw-Hill.

Reference Books:

1. Cyber Security Operations Handbook – by J.W. Rittiaghouse and William M.Han
2. Data Communications and Networking by Behrouz A Forouzan 5th edition

MOOC Links:

1. Cryptography and Network Security
   https://onlinecourses.nptel.ac.in/noc26_cs57/preview
2. Cryptography
   https://onlinecourses.swayam2.ac.in/cec25_cs03/preview

Program:	B.Tech. (Computer Science and Engineering)	Semester:	V
Course:	Program Elective Course-I Lab Cryptography and Network Security Lab	Code:	BTCSPE02CS5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: To enable students to evaluate and Design Secure network architecture using Cryptography Algorithms

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Break classical encryption schemes, including the Shift (Caesar) Cipher and the Mono-alphabetic Substitution Cipher	L4
CO-2	Apply OTP and Message Authentication codes to ensure confidentiality and integrity of messages in secure communication systems.	L3
CO-3	Apply cryptographic to ensure data integrity, authentication, and confidentiality in secure communication systems.	L4
CO-4	Implement secure data encryption and key exchange in communication systems.	L3
CO-5	Apply the Diffie–Hellman key establishment protocol to securely generate shared secret keys over an insecure communication channel.	L2
CO-6	Ensure secure key management, authentication, integrity, and non-repudiation in communication systems.	L3

List of practical

1. To analyze and break a shift (Caesar) cipher using brute-force and frequency analysis techniques to understand weaknesses of classical encryption methods.
2. To implement and break a mono-alphabetic substitution cipher using letter frequency analysis and pattern matching to demonstrate vulnerabilities in simple substitution ciphers.
3. To implement the One-Time Pad encryption scheme and verify its property of perfect secrecy by using truly random keys and comparing ciphertext patterns.
4. To implement message authentication using MAC algorithms and demonstrate data integrity and authentication between sender and receiver.
5. To implement cryptographic hash functions and study their applications in password hashing, data integrity verification, and digital fingerprinting.

6. To implement the DES encryption and decryption algorithm and analyze its structure, key size and security limitations.
7. To implement the AES encryption and decryption algorithm.
8. To implement the Diffie-Hellman key exchange protocol and demonstrate secure key establishment over an insecure communication channel.
9. To implement RSA encryption and decryption using PKCS v1.5 padding and study its role in secure data transmission.
10. To implement digital signature schemes using RSA or DSA and verify message authenticity, integrity and non-repudiation.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Program Elective Course-I Internet of Things			Code:			BTCSPE03CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To provide students with a comprehensive understanding of the fundamental concepts of Internet of Things.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Outline the fundamental concepts, evolution, and applications of IoT.	L2
CO-2	Identify and use IoT sensors, actuators, devices, and communication technologies.	L3
CO-3	Describe IoT architecture, middleware, cloud, edge and fog computing.	L2
CO-4	Compare IoT protocols, networking standards, and interoperability requirements.	L4
CO-5	Apply basic IoT data management, analytics, and security techniques.	L3
CO-6	Demonstrate IoT applications using common IoT platforms and understand emerging trends.	L3

Unit I : : Introduction to Internet of Things **(6 Hrs.)**

Definition, basic concepts, evolution, Characteristics & enabling technologies, IoT architecture and components, IoT vs. traditional networks, Applications.

Unit II: IoT Devices, Sensors & Communication **(6 Hrs.)**

Sensors & actuators: types, characteristics, interfacing. IoT devices: microcontrollers, embedded systems, smart objects. Communication: Wi-Fi, Bluetooth, ZigBee, RFID, NFC, LPWAN: LoRaWAN, NB-IoT, Sigfox. Wireless models & network topologies

Unit III: Architecture, Middleware & Cloud **(6Hrs.)**

IoT layers: device, network, application. IoT middleware. Cloud–IoT integration, Edge & fog computing, SOA concepts for IoT

Unit IV: IoT Protocols and Standards **(6 Hrs.)**

Protocols: MQTT, CoAP, HTTP, XMPP, WebSocket. Networking: IPv6, 6LoWPAN, RPL. IoT standards: IEEE, IETF, ITU, OCF. LPWAN standards & limitations

Unit V: Data, Analytics & Security **(6 Hrs.)**

Data acquisition, collection, storage, processing. IoT data analytics, cloud platforms. Big data for IoT Threats, vulnerabilities, security models. Cryptography, authentication, secure communication, Privacy challenges

Approved in 6th Academic Council Meeting
Dated:- 30/03/2026

Unit VI: IoT Applications & Future Trends **(6 Hrs.)**

Smart homes, Smart cities. Industrial IoT, automation, smart factories. Agriculture IoT: smart irrigation, precision farming. Platforms: Arduino, Raspberry Pi, ESP32. IoT cloud platforms & APIs, AI/ML for IoT, 5G integration. Case studies.

Total: 36 Hrs

Textbooks:

1. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hill Publication, 2017
2. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, University Press, 2015

Reference Books:

1. Sudhir Kumar, Fundamentals of Internet of Things, CRC Press (Taylor & Francis Group), 1st Edition, 2022.
2. Nami Susan Kurian & Dr. S. Hamsa, *Introduction to Internet of Things*, Rudra Publications, 1st Edition, 2025.
3. Donald Norris, *The Internet of Things*, McGraw-Hill Education, 1st Edition, 2015

MOOC Links:

1. Introduction To Internet of Things
   https://onlinecourses.nptel.ac.in/noc22_cs53/preview

2. Design for Internet of Things
   https://nptel.ac.in/courses/108108098

Approved in 4th Academic Council Meeting
Dated:- 30/03/2026

Program:	B. Tech. (Computer Science and Engineering)			Semester:		V
Course:	Program Elective Course-I Lab Internet of Things Lab			Code:		BTCSPE04CS5P
Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	100

Course Objectives: To understand, design, and simulate basic Internet of Things systems by interfacing sensors and actuators for monitoring and automation applications.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Identify basic IoT concepts, components, sensors, actuators, and embedded devices used in IoT systems.	L2
CO-2	Demonstrate interfacing of sensors and actuators with Arduino using Tinkercad for data acquisition and control.	L3
CO-3	Apply Arduino programming techniques to simulate IoT-based monitoring and automation applications.	L3
CO-4	Analyze sensor inputs and system behaviour to implement condition-based control logic in IoT applications.	L4
CO-5	Design simple IoT solutions such as smart lighting, security, parking, and monitoring systems.	L6
CO-6	Develop complete device-level IoT applications using Tinkercad without physical hardware.	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. To simulate LED blinking using Arduino Uno in Tinkercad.
2. To control LED ON/OFF operation using a push button using Arduino in Tinkercad.
3. To design and simulate a traffic light control system using Arduino and LEDs in Tinkercad.
4. To interface a temperature sensor (TMP36) with Arduino and display temperature readings using Serial Monitor in Tinkercad.
5. To measure light intensity using an LDR sensor interfaced with Arduino in Tinkercad.
6. To design an automatic street light system using LDR and Arduino in Tinkercad.
7. To simulate ultrasonic distance measurement using HC-SR04 sensor and Arduino in Tinkercad.
8. To control a servo motor using PWM signals generated by Arduino in Tinkercad.
9. To implement motion detection using PIR sensor and Arduino in Tinkercad.
10. To design a temperature-based smart fan control system using Arduino and TMP36 sensor in Tinkercad.
11. To simulate a digital door lock system using keypad and Arduino in Tinkercad.
12. To design a water level monitoring system using ultrasonic sensor and Arduino in Tinkercad.
13. To simulate an automatic fire alarm system using temperature sensor and buzzer in Tinkercad.
14. To design an obstacle detection system using ultrasonic sensor and LED/buzzer in Tinkercad.
15. To simulate a smart parking system using ultrasonic sensors and Arduino in Tinkercad.
16. Design and develop a mini project by using Tinkercad such as watering the plant etc

Program:	B. Tech. (Computer Science and Engineering)			Semester:			V	
Course:	Program Elective Course-I Natural Language Processing			Code:			BTCSPE05CS5T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	0	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: Students will be able to understand the fundamentals of natural language processing.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Define fundamental NLP concepts including regular expressions, finite state automata, and types of morphology	L1
CO-2	Interpret word-level processing techniques such as N-gram models, POS tagging, TF-IDF, and word embeddings (Word2Vec, GloVe)	L2
CO-3	Apply syntactic analysis techniques using context-free grammars, parsing methods, and probabilistic models to analyze sentence structures.	L3
CO-4	Analyze semantic structures using techniques such as predicate logic, word sense disambiguation, and syntax-driven semantic analysis.	L4
CO-5	Evaluate classification models such as Decision Trees and Naive Bayes for text classification tasks using appropriate performance metrics.	L5
CO-6	Develop information extraction systems including named entity recognition and relation extraction for real-world text data	L6

Unit I: Overview and Morphology **(6 Hrs.)**

Introduction Model and Algorithm, Regular Expression, Basic Regular Expression Patterns, Finite State Automata, Morphology, Inflectional Morphology, Derivational Morphology, Finite-State Morphology Parsing.

Unit II: Word Level Analysis **(6 Hrs.)**

Role of Language Models, Simple N-Gram models, stop word removal, stemming and Lemmatization, parts of Speech Tagging, Word Embeddings (Word2Vec, GloVe), TF-IDF, Hidden Markov models.

Unit III: Syntactic Analysis **(6 Hrs.)**

Context Free Grammars, grammar rules for English, Treebanks, Normal forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Probabilistic CFG, Probabilistic Lexicalized CFGs.

Unit IV: Semantic analysis **(6 Hrs.)**

Representing meaning, Meaning structure languages, First order Predicate calculus, Syntax-Driven Semantic Analysis, Semantic Attachments, Syntax-Driven analyzer, Robust Analysis, Relations among Lexemes and their senses, word Sense Disambiguation.

Unit V: Learning to Classify Text **(6 Hrs.)**

Approved in 4th Academic Council Meeting
Dated:- 30/03/2026

Supervised classification, Further examples of Supervised classification, evaluation, decision Trees, Naive Bayes Classifiers, Modelling Linguistic patterns.

Unit VI: Extraction Information from Text **(4 Hrs.)**

Information Extraction, Chunking, Developing and Evaluating chunks, Recursion in Linguistic structure, Named Entity Recognition, Relation Extraction.

Total: 36 Hrs

Textbooks:

1. "Speech and Language processing: An Introduction to Natural Language Processing, Computational Linguistic and Speech", Daniel Jurafsky, James H. Martin, Pearson Publication.

2. "Natural Language Processing with python", by Steven Bird, Ewan Klein and Edward Loper, Oreilly Media

Reference Books:

1. "Foundations of Statistical Natural language Processing", Christoper D. Manning and Hinrich Schuetze, MIT press

MOOC Links:

1. NPTEL Course: Exploratory Data Analysis for Data Science with R Software (By Prof. Shalabh, IIT Kanpur)
   https://onlinecourses.nptel.ac.in/noc26_cs07/preview

Program:	B. Tech. (Computer Science and Engineering)	Semester:	V
Course:	Program Elective Course-I Lab Natural Language Processing Lab	Code:	BTCSPE06CS5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: Students will be able to apply concepts of Natural language processing to process text data and understand sentiments.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Demonstrate Patterns in text and Morphology	L2
CO-2	Construct how to tag a given text with basics Language features	L3
CO-3	Design an innovative application using NLP components	L6
CO-4	Choose a rule-based system to tackle morphology/syntax of a language	L1
CO-5	Categorize a tag set to be used for statistical processing for real -time	L4
CO-6	Assess the use of different statistical approaches for different types of NLP applications	L5

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. Write a program to print the tokens of the given text document.
2. Write a program to convert text to lowercase, remove punctuation, and handle special characters.
3. Write a program for stop word removal using nltk library.
4. Write a program to generate Unigrams, Bigrams, and Trigrams from a given corpus.
5. Write a program to perform POS tagging.
6. Implement stemming and lemmatization to reduce words to their root forms.
7. Write a program to Convert text documents into a numerical matrix using Bag-of-Word method.
8. Implement Term Frequency-Inverse Document Frequency for a given sample text.
9. Write a program to perform named entity recognition like Person names, Locations, and Organizations.
10. Build a Spam vs. Ham (Email) classifier using a labeled dataset.
11. Implement ATS system to match candidate resume to the given job description.
12. Implement sentiment analyzer for the input text. (Positive / Negative).
13. Create a classifier to automatically classify incoming customer queries into categories (Billing, Technical Issue, Account, etc.).
14. Build a simple rule-based chatbot that responds to user queries using logic/regex.
15. Create a decision tree classifier to classify whether a given string is hateful or not using labelled data.

Program:	B. Tech. (Computer Science and Engineering)	Semester:	V
Course:	Comm. Engg. Project/Field project	Code:	BTCSFP01CS5P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	50	-	50

Course Outcomes: To enable students to identify and analyze real-world problems through surveys and case studies, and apply core computer science concepts to design effective solutions.

CO	Course Outcomes	BT Level (L1 to L6)
CO1	Identify a real-world problem and define appropriate project objectives.	L4
CO2	Apply core computer science concepts to design an effective system solution.	L3
CO3	Conduct surveys and case studies to collect relevant data using appropriate tools and methodologies.	L3
CO4	Analyze the collected data using analytical and critical thinking skills to understand problem patterns and causes.	L4
CO5	Propose feasible and innovative solutions to address the identified community problems.	L6
CO6	Effectively present and communicate project findings and solutions to the community	L2

General Guidelines:

1) A group of 10 to 15 students shall select a project domain from the provided list. The selection is not restricted to the listed domains; students may propose an alternative domain with prior approval from the Chairman of the Board of Studies (BoS).
2) Students will prepare a case study and will deliver it in nearby community.
3) Model/Mobile app/Web app could also be prepared.

Domain List

1. Healthcare & Biomedical Applications
2. Agriculture & Smart Farming
3. Education & E-Learning Systems
4. Banking & Financial Applications
5. Retail & E-Commerce Systems
6. Transportation & Traffic Management
7. Smart City Applications
8. Energy & Power Management
9. Manufacturing & Production Systems
10. Environment & Pollution Monitoring
11. Security & Surveillance Systems
12. Social Welfare & E-Governance
13. Tourism & Hospitality Management
14. Logistics & Supply Chain Management

15. Sports & Fitness Applications
16. Library & Information Management
17. Automobile & Vehicle Management
18. Real Estate & Property Management
19. Media & Content Management
20. Human Resource & Office Automation

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Compiler Design			Code:			BTCSPC20CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: Students will be expected to understand the core principles of compiler design, including translation, parsing, and code optimization.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand the fundamentals of compilers and the various phases involved.	L1
CO-2	Create LL and LR parsers	L6
CO-3	Solve the various parsing techniques like SLR, CLR, LALR.	L3
CO-4	Examine the concept of Syntax-Directed Definition and translation.	L4
CO-5	Assess the concept of Intermediate-Code Generation and run-time environment	L5
CO-6	Discuss the concept code generation and code optimization.	L2

Unit I: Introduction to Compiler (6 Hrs.)

Introduction to Compilers: Language Processor, The Structure of a Compiler. Lexical Analysis: The role of lexical analyzer, Input Buffering, Specification of tokens, Recognition of tokens, The lexical analyzer generator Lex.

Unit II: Syntax Analysis (6 Hrs.)

Syntax Analysis: The role of the parser, Review of context free grammar for syntax analysis: Parse Tree and Derivation, Ambiguity in Grammar, Elimination of left recursion and left factoring. Top-down parsing: recursive descent parsing, predictive parsers, Transition diagrams for predictive parsers, FIRST and FOLLOW, LL (1) Grammars, Construction of predictive parsing tables.

Unit III: Bottom-up parsing (6 Hrs.)

Bottom up parsing: Handle pruning, Stack implementation of Shift Reduce Parsing, conflicts during shift reduce parsing Introduction to LR parsing: Simple LR, Items and the LR(0) Automation, The LR-Parsing algorithm, Construction of SLR parsing table, More powerful LR Parsers: canonical LR(1) Items.

Unit IV: Syntax Directed Translation (6 Hrs.)

Syntax Directed Translation: Syntax directed definitions, Inherited and synthesized attributes, Evaluation orders of SDD's: Dependency Graphs, S-attributed definitions, L-attributed definition. Application of Syntax Directed Translation: Construction of syntax trees. Syntax-directed Translation Schemes.

Unit V: Intermediate-Code Generation (6Hrs.)

Intermediate-Code Generation: Variants of Syntax Trees: Directed Acyclic Graphs(DAG), Three Address Code. Run Time Environments: Storage Organization, Static versus Dynamic Storage Organization, Stack Allocation of Space: Activation trees, Activation Records, Calling Sequences.

Approved in Academic Council Meeting
Dated:- 30/03/2026

Unit VI: Code Generation **(6Hrs.)**

Code Generation: Issues in Design of a Code generator, The Target Language, Address in the target code, Basic blocks and flow graphs. Optimization of Basic Blocks, Peephole Optimization and The Principal sources of Optimization.

Total: 36 Hrs

Textbooks:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: —Principles, Techniques and Tools, Pearson Education Second Edition..

Reference Books:

1. D. M. Dhamdhere, Compiler Construction—Principles and Practice, (2/e), Macmillan India.
2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman Compilers: —Principles, Techniques and Tools, Pearson Education (Low Price Edition).
3. Andrew Appel, Modern Compiler Implementation in C, Cambridge University press.
4. K C. Louden —Compiler Construction—Principles and Practice|| India Edition, CENGAGE.
5. Bennett J.P., —Introduction to Compiling Techniques||, 2/e (TMH).

MOOC Links:

1. NPTEL Course: Compiler Design (By Prof. Santanu Chattopadhyay | IIT Khargpur) https://onlinecourses.nptel.ac.in/noc22_cs14/preview
2. Udemy Course: Mastering Compiler Design: Basics to Advanced Techniques https://www.udemy.com/course/mastering-compiler-design-basics-to-advanced-techniques/?couponCode=CP251129CMG1

Program:	B. Tech. (Computer Science and Engineering)	Semester:	VI
Course:	Compiler Design Lab	Code:	BTCSPC21CS6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: Students will be expected to apply core compiler design principles through practical implementation of lexical analysis, parsing methods, and code optimization techniques.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Recall and identify the basic concepts required for lexical analysis and compiler construction.	L1
CO-2	Describe how comments are recognized and how balanced parentheses are validated using regular expressions.	L2
CO-3	Apply finite automata techniques to simulate and validate input strings.	L3
CO-4	Analyze the structure of a symbol table and perform operations for efficient data handling.	L4
CO-5	Evaluate parsing strategies by implementing Recursive Descent and Shift–Reduce parsers.	L5
CO-6	Create deterministic finite automata for given strings and generate Three-Address Code for programs.	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Implement a C program to check parenthesis of regular expression is balanced or not.
4. Implement a C program to simulate Deterministic Finite Automation (DFA) for a string which ending with a or a*b or abb.
5. Write a C program to construct of DFA from NFA.
6. Implement a Lex program to verify the parenthesis of a given expression is balanced.
7. Implement a Lex program to recognize the token like Digit, Identifier & Delimiter.
8. Implement the Lexical Analyzer using JLex, flex or other lexical analyzer generating tools.
9. Implement a Lex program to a valid arithmetic expression and to recognize the identifier and operators present.
10. Implement a Lex program to count words, characters, lines, vowels and consonants from given input.
11. Implement a Lex program to check given number is positive negative or zero.
12. Implement a Lex program to generate string which is ending with zeros.
13. Implement LEX and Yacc tool to implement desk calculator.
14. Write a C program for constructing recursive descent parsing.

15. Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value.
16. Write functions to find FIRST and FOLLOW of all the variables / given grammar.
17. Implement a Shift Reduce Parser for the following productions.
    $E \rightarrow E+E / E*E / a / b$
18. Implement a symbol table containing functions create(), modify(), search(), display() and delete().
19. Implement three address Code for the input a=b*c.
20. Implement Recursive Decent Parser for the given productions.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Foundations of Data Science			Code:			BTCSPC22CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To provide students with fundamental knowledge of data science concepts and practical skills in data preprocessing, exploratory data analysis, machine learning algorithms, and ensemble methods using Python for real-world problem solving.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand fundamental fields, evolution and key terminologies related to Data Science.	L2
CO-2	Apply data preprocessing and exploratory data analysis techniques and data visualization using Python libraries.	L3
CO-3	Classify machine learning algorithms into supervised and unsupervised categories.	L4
CO-4	Apply supervised learning algorithms such as linear regression, decision trees, K-nearest neighbors, naïve Bayes, and support vector machines	L3
CO-5	Analyze data patterns in unsupervised learning techniques such as clustering and association rule mining.	L4
CO-6	Apply techniques such as bagging, boosting, and SMOTE	L3

Unit I: Introduction to Data Science **(6 Hrs.)**

Brief History of Data Science, Increasing Attention to Data Science, Fundamental Fields of Study Related to Data Science, Data Science and Related Terminologies, Big Data, Business Intelligence, Data Mining, Artificial Intelligence, Machine Learning, Deep Learning, Types of Analytics.

Unit II: Exploratory Data Analysis **(6 Hrs.)**

Steps in Data Preprocessing, Understanding Data, looking at the Data, Dealing with Outliers, Dealing with Missing Values, Standardizing Data, Steps Involved in EDA Using Python Programming, looking at the data, Treatment of Outliers, Data Visualization for Machine Learning, Techniques: Simple Data Visualization Using Python, Using Ggplots in Python, Matplotlib Library, Seaborn Library.

Unit III: Types of Machine Learning Algorithms **(6 Hrs.)**

Supervised Learning Algorithms: Regression, Classification, Introduction to Unsupervised Learning Algorithms: Clustering, Association Rule Mining.

Unit IV: Supervised Learning Algorithms **(6 Hrs.)**

Simple Linear Regression, multiple Linear Regression, Logistic Regression, Decision Tree, Classification and Regression Technique, Random Forest, K-Nearest Neighbors, Naïve Bayes Algorithm, SVMs.

Unit V: Un-Supervised Learning Algorithms **(6 Hrs.)**

Association Rule Mining, Conjoint Analysis, Clustering, K Means Clustering.

Unit VI: Ensemble Methods **(6 Hrs.)**

Introduction: Dealing with Imbalanced Data, Ensemble Methods, Bias Variance Tradeoff, Bagging Boosting, Synthetic Minority over Sampling Technique (SMOTE)

Total: 36 Hrs

Textbooks:

1. Introduction to Data Science: Practical Approach with R and Python- B. Uma Maheswari (Author), R. Sujatha (Author)

Reference Books:

1. Chirag Shah," A Hands-on Introduction to Data Science ", Cambridge University Press (2020) ISBN:978-1-108-47244-9.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani: An Introduction to Statistical Learning with Applications in Python ,978-3-031-38747-0 Published: 30 June 2023.
3. Cathy O'Neil and Rachel Schutt: Doing Data Science, First Edition, 2014, O'reilly Publications, ISBN:978-1-449-35865-5.

MOOC Links:

1. NPTEL Course: Data Science for Engineers
   Link: https://onlinecourses.nptel.ac.in/noc26_cs65/preview
2. NPTEL Course: Python for Data Science
   Link: https://onlinecourses.nptel.ac.in/noc26_cs80/preview

Program:	**B. Tech. (Computer Science and Engineering)**	**Semester:**	**VI**
Course:	**Foundations of Data Science Lab**	**Code:**	**BTCSPC23CS6P**

Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**0**	**2**	**2**	**30**	**20**	**50**

Course Objectives: Develop practical skills in data science, including analytics, data preprocessing, visualization, and machine learning techniques, for effective data-driven decision-making

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO-1	Understand fundamental concepts, terminologies, applications of Data Science, and types of analytics.	L2
CO-2	Apply data preprocessing techniques to handle missing values and outliers for improved data quality.	L3
CO-3	Perform exploratory data analysis and data visualization to identify patterns and relationships in datasets.	L4
CO-4	Implement unsupervised learning techniques such as clustering and association rule mining on datasets.	L3
CO-5	Implement supervised learning algorithms for classification and prediction tasks.	L3
CO-6	Evaluate and compare the performance of different Data Science and ensemble algorithms to improve prediction accuracy.	L5

General Guidelines: Minimum 8 practical are to be conducted covering entire syllabus.

Experiment List

1. To install and use Python libraries (NumPy, Pandas, Matplotlib, Seaborn, Scikit-learn).
2. Implement Data Loading and Dataset Understanding using Python.
3. To perform data preprocessing by handling missing values using mean, median, and mode.
4. To find outliers using IQR, Z-score, and boxplot analysis.
5. To standardize and normalize data using Min-Max scaling and standard scaling.
6. To perform exploratory data analysis (EDA) using summary statistics.
7. To visualize data using bar chart, histogram, and pie chart.
8. To implement K-Means clustering algorithm.
9. To implement association rule mining using Apriori algorithm.
10. To implement linear and logistic regression models.
11. To implement Decision Tree and Random Forest algorithms.
12. To implement K-Nearest Neighbors (KNN), Naïve Bayes, and SVM classifiers.
13. To evaluate model performance using accuracy, precision, recall, F1-score, RMSE, and R^2.
14. ·To develop a sentiment analysis system using relevant datasets.
15. To develop a prediction system using machine learning techniques.
16. To perform fraud detection using imbalanced data handling techniques (SMOTE) and ensemble methods.

Approved in.....
Academic Council Meeting
Dated:- 30/03/2026

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Program Elective Course-II Data Analytics			Code:			BTCSPE07CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	0	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To understand the basic concepts of Data Analytics and implement it.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Determine the most appropriate type of analytics (descriptive, diagnostic, predictive, or prescriptive) required to solve a problem.	L4
CO-2	Apply measures of central tendency and dispersion and perform Hypothesis testing	L3
CO-3	Prepare raw data for analysis by implementing techniques for handling missing values, detecting outliers	L4
CO-4	Select appropriate data visualizations using Matplotlib and Seaborn.	L5
CO-5	Build Supervised machine learning model for classification of data.	L6
CO-6	Apply Unsupervised Machine Learning techniques, specifically clustering or Association rule mining to discover patterns in unlabelled data.	L3

Unit I: Introduction to data analytics (8 Hrs.)

Data and Information, Types of data: continuous vs discrete data. Types of analytics: descriptive, diagnostic, predictive, prescriptive analytics. Sample vs Population. Importance of data analysis, applications of data analysis, data analysis life cycle, Introduction to R: data structures, basic programming.

Unit II: Statistics for data analytics (6 Hrs.)

Measure of central tendency: mean, median and mode. Measure of dispersion of data: standard deviation, variance and spread of the data. Hypothesis, Null and alternate hypothesis, Type-I and Type-II error, p-value and significance level(α), Hypothesis testing: ANOVA, Chi-square test.

Unit III: Preprocessing and Exploratory Data Analytics (6 Hrs.)

Need for preprocessing, Data cleaning techniques: Handling missing values, Outlier detection: IQR method and box plot analysis, Data normalization: Min-Max scaling, Sampling techniques: Random sampling, Stratified sampling.

Unit IV: Visualization for Data Analysis (6 Hrs.)

Bar graph and pie chart: To compare categorical values, scatter plot: To perform bi-variate analysis, histogram and box plot: Perform frequency distribution analysis, line graph: For temporal data, matplotlib and seaborn library from Python.

Unit V: Introduction Machine Learning **(6 Hrs.)**

Types of Machine learning: Supervised, Unsupervised and reinforcement. Regression and Classification, Support vector Machine, Decision Tree algorithm, Introduction to unsupervised machine learning, clustering: K-means clustering, Association rule mining.

Unit VI: Advanced Analytics **(4 Hrs.)**

Time series analysis: Basics of trends, seasonality, forecasting using forecast package, Text Mining: Sentiment analysis, word cloud using tm and tidytext.

Total: 36 Hrs

Textbooks:

1. "Data Analytics using R", Seema Acharya, McGraw Hill Education (India)
2. "Data Analytics made accessible", by Dr. Anil Maheshwari

Reference Books:

1. Programming in R with Applications in Machine Learning and Data Analytics, Priyanka P. Shinde, Varsha P. Desai, Kavita S. Oza, and Rajanish K. Kamat

MOOC Links:

1. NPTEL Course: Exploratory Data Analysis for Data Science with R Software (By Prof. Shalabh, IIT Kanpur)
   https://onlinecourses.nptel.ac.in/noc26_cs07/preview

Program:	B. Tech. (Computer Science and Engineering)	Semester:	VI
Course:	Program Elective Course-II Lab Data Analytics Lab	Code:	BTCSPE08CS6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: To perform data analysis using various python libraries and visualization techniques.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Apply appropriate data retrieval techniques to read data from external source (.csv file or excel file) into a dataframe.	L3
CO-2	Determine central tendency and measure of spread of the data.	L5
CO-3	Analyse the data using various visualization methods.	L4
CO-4	Perform data preprocessing by removing null values, perform outlier detection and apply data normalization.	L4
CO-5	Create advanced dashboard using PowerBi / Tableau for data analytics	L6
CO-6	Apply machine learning algorithm to the given dataset.	L3

General Guidelines: Practical to be conducted on Jupyter Notebook or Google Colab.

Experiment List

1. Install R and RStudio.
2. To read data from a .CSV file, excel file into a data frame.
3. Import mtcars data into a csv file and calculate mean and median for any numeric column. (Example: weight, disp etc)
4. Import mtcars data into a csv file and calculate standard deviation and variance of the numeric columns.
5. Use the dplyr package to perform data transformation on the mtcars or iris dataset. Implement filter(), select(), mutate(), and summarise() with the pipe operator %>%
6. Implement techniques (e.g., imputation with mean/median or dropping rows) to handle missing values in a dataset.
7. To find and display outliers using IQR method from a box plot.
8. Perform univariate analysis using histogram for continuous data. (IRIS or mtcars)
9. Perform univariate analysis using Bar graph for categorical data. (mtcars)
10. Perform bivariate analysis using scatter plot. (Iris dataset)
11. Perform an **ANOVA** test on a sample dataset (e.g., comparing mean scores across multiple groups) and interpret the p-value.
12. Build and train a Decision Tree Classifier for a classification problem.
13. Implement Linear regression model to predict target variable.
14. Calculate accuracy of classification algorithm.
15. Perform time series decomposition on the Air Passengers dataset to extract trend and seasonality. Apply a simple forecasting model using the forecast package.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Program Elective Course II- Neural Network			Code:			BTCSPE09CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To equip students with foundational knowledge of neural network models, learning rules, architectures, and training algorithms.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the fundamental concepts, components, and biological inspiration of artificial neural networks.	L1
CO-2	Understand basic neuron models and various learning rules used for training neural networks.	L2
CO-3	Apply perceptron, ADALINE, and MADALINE architectures and algorithms to solve simple classification problems.	L3
CO-4	Analyze associative memory models and implement pattern storage and retrieval using auto-associative and BAM networks.	L4
CO-5	Evaluate the behaviour of Hopfield and RBF networks and use them for pattern recognition or function approximation tasks.	L5
CO-6	Design and train backpropagation-based multilayer networks and assess their performance and limitations.	L6

Unit I: Introduction to Neural Networks **(6 Hrs.)**

Introduction, artificial neural networks, historical development of neural networks, biological neural networks, biological vs artificial neural networks, basic building block of neural networks, neural network terminologies.

Unit II: Fundamentals Models of Neural Networks **(6 Hrs.)**

Introduction, McCulloch-Pitts neuron model, Learning rules: Hebbian learning, perceptron learning, delta learning, competitive Learning, Out-star learning, Boltzmann learning, Hebb Net.

Unit III: Perceptron Networks **(6 Hrs.)**

Introduction, Single-layer perceptron: architecture, algorithm, application procedure, perception algorithm for several output classes, multilayer perceptron network, Adaline networks: architecture, algorithm and Madaline networks: architecture, algorithm.

Unit IV: Associative Memory Networks **(6 Hrs.)**

Introduction, algorithms for pattern association: Hebb rule, delta rule, auto-associative memory networks: architecture, training algorithm, bidirectional associative memory networks: architecture, types of networks.

Unit V: Feedback Networks and Radial Basis Function Networks **(6 Hrs.)**

Introduction, Discrete Hopfield Net: architecture and training algorithm, Relation between BAM and Hopfield Nets, radial basis function network: architecture, training algorithm for an RBFN with fixed centres.

Unit VI: Back Propagation networks **(6 Hrs.)**

Introduction, back propagation network: delta learning rule, architecture, training algorithm, selection of parameters, learning in back propagation, application algorithm, local minima and global minima, merits and demerits of BPN

Total: 36 Hrs

Textbooks:

1. S. N. Sivanandam, S. Sumathi & S. N. Deepa, *Introduction to Neural Networks using MATLAB (6.0)*, McGraw-Hill.

Reference Books:

1. Jacek M Zurada, " Introduction to artificial neural systems".
2. S. Haykin, "Neural networks and Learning Machines", Pearson Education, 2nd Edition.
3. S. Haykin, "Neural networks and Learning Machines", Pearson Education, 3rd Edition.

MOOC Links:

1. NPTEL Course: Neural Networks and Applications (By Prof. Somnath Sengupta, IIT Kharagpur) https://nptel.ac.in/courses/117105084

Program:	**B. Tech. (Computer Science and Engineering)**	**Semester:**	**VI**
Course:	**Program Elective Course-II Neural Network Lab**	**Code:**	**BTCSPE10CS6P**

Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	0	2	1	30	20	50

Course Objectives: Enable students to implement, train, and evaluate various neural network models and learning algorithms for effective pattern recognition and classification tasks.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO-1	Describe basic neural network concepts, architectures, activation functions, and neuron models.	L1
CO-2	Understand various learning rules such as Hebbian, Perceptron, Delta, and Out-star for training simple neural models.	L2
CO-3	Train perceptron, ADALINE, and MADALINE networks for binary and multi-class classification.	L3
CO-4	Implement associative memory networks such as BAM and Auto-Associative Networks for bidirectional recall and pattern storage.	L4
CO-5	Develop and test feedback-based models and radial basis function networks for stable recall and nonlinear function approximation.	L5
CO-6	Design multilayer neural networks using backpropagation for solving complex, non-linearly separable problems.	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. *Study of Artificial Neural Networks and Basic Terminologies.*
2. Implement Linear, ReLU, and Softmax Activation Functions across ranges of inputs.
3. Simulate a basic McCulloch–Pitts Neuron Model.
4. Train a weight matrix using Hebbian learning rule.
5. Implement a Perceptron Learning Rule to classify linearly separable patterns.
6. Train a neuron using Delta Learning Rule.
7. Train a simple feedforward network using the out-star learning method.
8. Simulate a stochastic binary network learning process.
9. Build and test a Single-Layer Perceptron for Multi-Class Classification.
10. Implement and Compare performance of ADALINE vs MADALINE for pattern classification.
11. Use Multilayer Perceptron (MLP) to classify 2-class or multi-class datasets.
12. Demonstrate forward and backward recall between pattern pairs using BAM.
13. Test energy minimization and stable pattern recall.
14. Train an RBF network with fixed centres.
15. *Train a multilayer network to solve non-linearly separable tasks.*
16. Build, train, and evaluate a custom neural network model (mini projects).

Program:	B. Tech. (Computer Science and Engineering)	Semester:	VI
Course:	Program Elective Course-II Block Chain Technology	Code:	BTCSPE11CS6T

Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To introduce students to blockchain principles, cryptographic foundations, consensus mechanisms, and smart contract development for building secure decentralized applications.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the fundamental concepts, structure, and applications of blockchain technology.	L2
CO-2	Examine basic cryptographic techniques and their role in securing blockchain systems.	L4
CO-3	Illustrate the working of consensus mechanisms and identify their suitability for different blockchain networks.	L2
CO-4	Analyse the working of Bitcoin, including transactions, wallets, and mining concepts.	L4
CO-5	Compare Ethereum and Bitcoin in terms of architecture, functionality, and smart contract support	L4
CO-6	Apply blockchain concepts to design and develop simple decentralized applications using Ethereum.	L3

Unit I: Blockchain Fundamentals **(6 Hrs.)**

Introduction to Blockchain, History, centralised versus Decentralised systems, layers of blockchain, Importance of blockchain, Blockchain uses and use cases.

Unit II: Blockchain Working with Cryptography **(6 Hrs.)**

Laying the Blockchain Foundation, Cryptography, Symmetric Key Cryptography, DES cryptography, Advanced Encryption Standard, Cryptographic Hash Functions, Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography

Unit III: Consensus Algorithms **(6 Hrs.)**

Introducing the consensus problem, Analysis and design, Classification, Algorithms: CFT algorithms, BFT algorithms, Choosing an algorithm

Unit IV: Bitcoin & Its Working **(6 Hrs.)**

The History of Money, Dawn of Bitcoin: What Is Bitcoin, Working with Bitcoins. The Bitcoin Blockchain: Block Structure, The Genesis Block. The Bitcoin Network: Network Discovery for a New Node Bitcoin Transactions, Bitcoin Wallets

Unit V: Ethereum **(6 Hrs.)**

From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum Blockchain, Ethereum Accounts, Trie Usage Merkle Patricia, Tree RLP Encoding Ethereum Transaction and Message Structure, Ethereum Smart Contracts Contract Creation.

Unit VI: Blockchain Application Development **(6 Hrs.)**

Decentralized Applications, Blockchain Application Development, interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum, Sending Transactions

Total: 36 Hrs

Textbooks:

1. Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Apress 2018
2. Mastering Blockchain, Imran Bashir: Packt- Birmingham-Mumbai Third Edition A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, crypto currencies, Ethereum, and more

Reference Books:

1. Blockchain – Blueprint for new Economy Melanie Swan - O'reilly
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Sainul Abideen, Blockchain- ebook, Cybrosys Private Limited.

MOOC Links:

1) NPTEL Course: Blockchain and its Applications by Prof. Sandip Chakraborty, Prof. Shamik Sural | IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2) Udemy: The Complete Course on Understanding Blockchain Technology
https://www.udemy.com/course/understanding-blockchain-technology/

Program:	**B. Tech. (Computer Science and Engineering)**	**Semester:**	**VI**
Course:	**Program Elective Course-II Lab Blockchain Technology Lab**	**Code:**	**BTCSPE12CS6P**

Teaching Scheme				**Evaluation Scheme**		
Practical	**Tutorial**	**Hours**	**Credit**	**INT**	**EXT**	**Total**
2	**0**	**2**	**1**	**30**	**20**	**50**

Course Objectives: Students will be expected to create program from their understanding of Object-Oriented programming using java.

Course Outcomes: After completion of the course, the students will be able to:

CO	**Course Outcomes**	**BT Level** (L1 to L6)
CO-1	Understand the fundamentals of blockchain technology, cryptographic primitives, and development environments.	L1
CO-2	Design cryptographic algorithms such as Diffie–Hellman, RSA, and SHA	L2
CO-3	Develop simple blockchain structures, custom cryptocurrencies, and consensus mechanisms such as PoW and PoS.	L3
CO-4	Implement Bitcoin-specific operations including private/public key generation and transaction signature verification.	L3
CO-5	Design smart contracts using Solidity in Remix IDE.	L5
CO-6	Integrate concepts of blockchain, cryptography, and smart contracts to build secure decentralized applications.	L6

General Guidelines: Minimum 8 practical's are to be conducted covering entire syllabus.

Experiment List

1. Understand basics of Block Chain and install various software's required to perform various practical's
2. Implement a Diffie-Hellman Algorithm
3. Implement various SHA algorithms
4. Implement RSA Encryption and Decryption
5. Create a Simple Blockchain
6. Implement the consensus mechanism Proof of Work (POW)
7. Implement the consensus mechanism Proof of Stake (POS)
8. Create Your Own Cryptocurrency
9. Generate Bitcoin Private Key & Public Key
10. Verify a Bitcoin Transaction Signature
11. Design a simple smart contract
12. Create a smart contract for Merkle tree
13. Write a Smart Contract for Storing & Retrieving Data
14. Implement a Smart Contract for Simple Bank System
15. Create a Smart Contract for Supply Chain Management

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Program Elective Course-III Software Testing and Quality Assurance			Code:			BTCSPE13CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To develop students' competence in software testing principles, techniques, management practices, automation tools, and quality standards for delivering high-quality software systems.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Describe the fundamentals, principles, and life cycles of software testing to understand the role and process of testing.	L2
CO-2	Apply black-box and white-box test case design techniques to create effective test scenarios and test cases.	L3
CO-3	Analyze various levels and types of testing to select suitable testing approaches for different software contexts.	L4
CO-4	Evaluate test management processes including Infrastructure management, Test people management and Test Reporting.	L5
CO-5	Design automation strategies by understanding automation architecture, and selecting appropriate tools.	L5
CO-6	Assess software quality standards and models to ensure software process improvement and product quality assurance.	L6

Unit I: Fundamentals of Software Testing **(6 Hrs.)**

Definition and Need for Software Testing, Errors, Faults, Failures, Software Development life cycle vs Software Testing Life Cycle, Verification, Validation, Life Cycle Models: Waterfall, Spiral and V Model.

Unit II: Test Design Techniques: White-Box & Black-Box **(6 Hrs.)**

White Box Testing, Structural Testing: Code Coverage Testing, Code Complexity Testing, Black Box Testing: Boundary Value Analysis, Decision Tables, Equivalence Class Partitioning, State Based/Graph Based Testing.

Unit III: Testing Levels and Testing Types **(6 Hrs.)**

Unit Testing, Integration Testing: Top Down and Bottom Up, System Testing: Functional System Testing: Deployment Testing, Beta Testing, Regression testing: Smoke & Sanity testing, Non-Functional Testing: Scalability Testing, Reliability Testing, Performance Testing: Load Testing, Stress Testing, Acceptance Testing.

Unit IV: Test Management **(6 Hrs.)**

Test Planning, Test Management: Choice of Standards, Test Infrastructure Management, Test People Management, Integrating with Product Release, Test Process, Test Reporting: Recommending Product Release.

Unit V: Software Test Automation **(6 Hrs.)**

Introduction to Test Automation, Automation vs Manual Testing, Design and Architecture for Automation, Process Model for Automation, Selecting a Test Tool.

Unit VI: *Software Quality Assurance & Standards* **(6 Hrs.)**

Introduction: Concepts and Definition, Cost of Quality, QA vs QC, SQA Lifecycle Phases, Software process models: ISO 12207, CMM, CMMI.

Total: 36 Hrs

Textbooks:

1. Software Testing: Principles and Practices by Srinivasan Desikan & Gopalaswamy Ramesh (Publisher: Pearson Education)
2. Software Testing: Hema khurana (Publisher: Pearson Education)

Reference Books:

1. William E. Perry – Effective Methods for Software Testing, Wiley Louise Tamres
2. Software Testing, PearsonCem Kaner, Jack Falk, Hung Q. Nguyen – Testing
3. Paul Jorgensen – Software Testing: A Craftsman's Approach, CRC Press Ian

MOOC Links:

1. https://www.udemy.com/course/introduction-to-software-testing-or-software-qa
2. https://www.udemy.com/course/software-testing-simple
3. https://onlinecourses.nptel.ac.in/noc25_cs66

Approved in 4th Academic Council Meeting
Dated:- 30/03/2026

16. Test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
17. Test a program to provide total number of objects present / available on the page.
18. Test a program to get the number of items in a list / combo box.
19. Test a program to count the number of check boxes on the page checked and unchecked count.
20. Load Testing using JMeter, Android Application testing using Appium Tools, Bugzilla Bug tracking tools.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Program Elective Course-III Data Mining & Data Warehousing			Code:			BTCSPE15CS6T	
Teaching Scheme				*Evaluation Scheme*				
Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**MSE-I**	**MSE-II**	**ESE**	**Total**
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: Throughout the course, Students will learn to apply appropriate data mining techniques for effective decision making and develop research interest in advanced data mining concepts.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand the basics of data mining techniques.	L2
CO-2	Evaluate the similarity and dissimilarity between the data sets.	L5
CO-3	Apply appropriate Data Preprocessing techniques for improving data quality.	L4
CO-4	Analize Data Warehouse fundamentals & Data Mining Principles.	L4
CO-5	Design Multidimensional Data Analysis using data cube technology	L3
CO-6	Prepare model for Mining Frequent Patterns, Associations, and Correlations	L3

Unit I: Introduction to Data Mining **(6 Hrs.)**

Need and importance of Data Mining, Definition and concept of Data Mining, Types of data suitable for Data Mining, Types of patterns discovered through Data Mining, Technologies used in Data Mining, Application areas of Data Mining, Major issues and challenges in Data Mining.

Unit II: Getting to Know Your Data **(6 Hrs.)**

Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

Unit III: Data Preprocessing **(6 Hrs.)**

Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization, Outliers & Outlier Analysis, Outliers detection methods

Unit IV: Data Warehousing and Online Analytical Processing **(6 Hrs.)**

Data Warehousing and Online Analytical Processing: Data Warehouse: Basic Concepts, Data Warehouse Modelling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction

Unit V: Data Cube Technology **(6 Hrs.)**

Data Cube Computation: Preliminary Concepts, Data Cube Computation Methods, Processing Advanced Kinds of Queries by Exploring Cube Technology, Multidimensional Data Analysis in Cube Space

Unit VI: Mining Frequent Patterns, Associations, and Correlations **(6 Hrs.)**

Concepts and Methods: Basic Concepts, Frequent Itemset Mining Methods, Interesting Patterns in Data Mining, Pattern Evaluation Methods, Bayesian Classification methods, Classification by Backpropagation: Multilayer Feed-Forward Neural Network.

Total: 36 Hrs

Approved in 4th Academic Council Meeting
Dated:- 30/03/2026

Textbooks:

1. Data Mining – Concepts and Techniques, Jiawei Han & Micheline Kamber, Morgan Kaufmann (MK) Publishers, Elsevier, 3rd Edition, 2006.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd edition, Orient Blackswan/Universities Press, 2013.
2. Data Warehousing Fundamentals, Paulraj Ponnaiah, John Wiley & Sons, 2001.
3. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson Education, 2007
4. *Insight into Data mining Theory and Practice*, K.P. Soman, Shyam Diwakar and V. Ajay, Easter Economy Edition, Prentice Hall of India, 2006.
5. G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.

MOOC Links:

1. Data Mining
   https://onlinecourses.nptel.ac.in/noc26_cs58/preview
2. Data Mining for Decision Making
   https://onlinecourses.nptel.ac.in/noc26_cs14/preview

Program:	B. Tech. (Computer Science and Engineering)	Semester:	VI
Course:	Program Elective Course-III Lab Data Mining & Data Warehousing Lab	Code:	BTCSPE16CS6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	0	2	1	30	20	50

Course Objectives: To provide hands-on experience in applying data mining techniques and data warehousing concepts for extracting meaningful insights from large datasets.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Understand the various kinds of tools for data mining	L2
CO-2	Analyse the efficient distribution of information and easy access to data	L4
CO-3	Applying the concept of preprocessing of data	L4
CO-4	Demonstrate the concept of data mining	L3
CO-5	Design multidimensional data analysis in cube space	L3
CO-6	Create model for Mining Frequent Patterns, Associations, and Correlations	L6

General Guidelines: Example: - Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. To study the environment, interface, and functionalities of WEKA, and RapidMiner tools.
2. To visualize datasets using histograms, boxplots, heatmaps, scatterplots for understanding data distribution using WEKA tool.
3. To perform five element summary statistics, Similarity and Dissimilarity between data objects using WEKA tool.
4. To perform data cleaning, missing value handling, and data transformation using the RapidMiner tool for preparing data suitable for data mining analysis.
5. To apply dimensionality reduction techniques such as Principal Component Analysis (PCA), feature selection, and sampling methods using the RapidMiner tool
6. To detect and analyse outliers using Z-score, IQR, DBSCAN, and Isolation Forest methods with the RapidMiner tool.
7. Implementing Classification Using WEKA-To build and evaluate classification models using Naive Bayes, Decision Tree, and k-NN in WEKA.

8. To generate association rules using Apriori and FP-Growth algorithms and evaluate rule interestingness using WEKA tool.
9. To build a multilayer feed-forward neural network using backpropagation and evaluate accuracy using WEKA tool.
10. To create a multidimensional data cube using RapidMiner OLAP operators and perform roll-up, drill-down, slice, and dice operations.
11. To study a real-world application of data warehousing and data mining by analysing data sources, designing a data warehouse, and applying data mining techniques to derive meaningful insights.
12. To design and implement a mini project using data warehousing and data mining techniques for data analysis and knowledge discovery using suitable tools.
13. Study and implementation of Data Warehouse design and usage for business analysis.
14. Perform data generalization using Attribute-Oriented Induction.
15. Case study-based analysis using Data Warehousing and OLAP tools.

Program:	B. Tech. (Computer Science and Engineering)			Semester:			VI	
Course:	Program Elective Course-III Data Science for Cyber Security and Forensic			Code:			BTCSPE17CS6T	
Teaching Scheme				Evaluation Scheme				
Lecture	Tutorial	Hours	Credit	TA	MSE-I	MSE-II	ESE	Total
3	-	3	3	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz & Class Attendance

Course Objectives: To introduce the concepts of data science and machine learning and their applications in cyber security and digital forensics.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level
CO-1	Understand the fundamental concepts of Data Science and Machine Learning and their applications in Cyber Security for threat detection and prevention.	L2
CO-2	Apply and compare supervised and unsupervised machine learning algorithms for solving cyber security problems such as classification and clustering of security events.	L3
CO-3	Analyze security datasets and design anomaly detection models for identifying intrusions in host systems, network traffic, and web applications.	L4
CO-4	Evaluate malware behaviour using appropriate feature engineering techniques including feature generation, selection, and transformation.	L5
CO-5	Build, train, and evaluate machine learning models for cyber security applications using suitable datasets and performance metrics.	L5
CO-6	Design and assess machine learning–based cyber security solutions for intrusion detection, threat intelligence, and automated security monitoring.	L6

Unit I: Introduction of Data Science for Cyber Security (6 Hrs.)

Cyber Threat Landscape, The Cyber Attacker's Economy, A Marketplace for Hacking Skills-indirect Monetization, What Is Machine Learning? What Machine Learning Is Not Adversaries Using Machine Learning Real-World Uses of Machine Learning in Security Spam Fighting: An Iterative Approach Limitations of Machine Learning in Security

Unit II: Machine Learning Techniques for Security: Classifying and Clustering (6 Hrs.)

Machine Learning: Problems and Approaches, Machine Learning in Practice: A Worked Example, Training Algorithms to Learn, Model Families, Loss Functions, Optimization, Supervised Classification Algorithms, Logistic Regression, Decision Trees, Decision Forests, Support Vector Machines, Naive Bayes, k-Nearest Neighbors, Neural Networks, Practical Considerations in Classification, Selecting a Model Family, Training Data Construction, Feature Selection, Overfitting and Underfitting, Choosing Thresholds and Comparing Models, Clustering, Clustering Algorithms

Unit III: Anomaly Detection in Context of Security (6 Hrs.)

When to Use Anomaly Detection Versus Supervised Learning, Intrusion Detection with Heuristics, Data-Driven Methods, Feature Engineering for Anomaly Detection, Host Intrusion Detection, Network Intrusion Detection, Web Application Intrusion Detection, Anomaly Detection with Data and Algorithms, Forecasting (Supervised Machine Learning),Statistical Metrics, Goodness-of-Fit, Unsupervised Machine Learning Algorithms, Density-Based Methods, Challenges of Using Machine

Learning in Anomaly Detection, Response and Mitigation, Practical System Design Concerns, Optimizing for Explain ability, Maintainability of Anomaly Detection Systems, Integrating Human Feedback, Mitigating Adversarial Effects

Unit IV: Malware Analysis for Digital Forensics **(6 Hrs.)**

Understanding Malware, Defining Malware Classification, Malware: Behind the Scenes, Feature Generation, Data Collection, Generating Features, Feature Selection, From Features to Classification, How to Get Malware Samples and Labels

Unit V: Network Forensics: Network Traffic Analysis **(6 Hrs.)**

Theory of Network Défense, Access Control and Authentication, Intrusion Detection, Detecting In-Network Attackers, Data-Centric Security, Honeypots, Machine Learning and Network Security, From Captures to Features, Threats in the Network, Botnets , Building a Predictive Model to Classify Network Attacks, Exploring the Data, Data Preparation, Classification, Supervised Learning, Semi-Supervised Learning, Unsupervised Learning, Advanced Ensembling

Unit VI: Protecting Consumer Web **(6 Hrs.)**

Monetizing the Consumer Web, Types of Abuse, Authentication and Account Takeover, Account Creation, Financial Fraud, Bot Activity, Supervised Learning for Abuse Problems, Labeling Data, Cold Start Versus Warm Start, False Positives and False Negatives, Multiple Responses, Large Attacks, Clustering Abuse, Example: Clustering Spam Domains, Generating Clusters, Scoring Clusters, Further Directions in Clustering

Total: 36 Hrs

Textbooks:

1. A Text Book of Machine Learning and Security by Clarence Chio, David Freeman, O'reilly publication.

Reference Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN:978-81- 265-21791,20132.
2. A Text Book of Guide Computer Forensics Investigations ,6e, Bill Nelson, Steuart, Philips Publication.
3. Joseph MiggaKizza,"A Guide to Computer Network Security", Springer 2009.

MOOC Links:

1. https://nptel.ac.in/courses/106106179
2. https://nptel.ac.in/courses/106106139
3. https://nptel.ac.in/courses/106106248

Program:	B. Tech. (Computer Science and Engineering)	Semester:	VI
Course:	Program Elective Course-III Lab Data Science for Cyber Security and Forensics Lab	Code:	BTCSPE18CS6P

Teaching Scheme				Evaluation Scheme		
Practical	Tutorial	Hours	Credit	INT	EXT	Total
2	-	2	1	30	20	50

Course Objectives: To understand the fundamentals of Data Science and its applications in Cyber Security and Forensics.

Course Outcomes: After completion of the course, the students will be able to:

CO	Course Outcomes	BT Level (L1 to L6)
CO-1	Demonstrate understanding of data science concepts and workflows and interpret their applications in cyber security and digital forensics investigations.	L2
CO-2	Install, configure, and operate machine learning and data analysis tools (such as Python, Jupyter Notebook, or ML libraries) for processing security datasets.	L3
CO-3	Implement supervised and unsupervised machine learning algorithms to perform classification and clustering on cyber security datasets.	L3
CO-4	Analyze datasets by identifying features, dimensions, key attributes, and metadata to understand data structure and relevance for security analysis.	L4
CO-5	Develop and evaluate machine learning models for applications such as spam detection, abusive content detection, and anomaly detection using suitable performance metrics.	L5
CO-6	Perform digital forensic investigations using standard forensic tools for disk imaging, data acquisition, mobile forensics, file recovery, and network traffic analysis.	L3

General Guidelines: Minimum 8 practicals are to be conducted covering entire syllabus.

Experiment List

1. Study of Cyber Security for Data Science
   Study the role of data science techniques in cyber security, including threat detection, intrusion detection, malware analysis, and digital forensics.
2. Installation and Exploration of Machine Learning Tools
   Install and explore any one machine learning tool such as Weka, TensorFlow, Scikit-learn, or Google Colab, and demonstrate basic ML operations.
3. Exploratory Data Analysis (EDA) using Python
   Write a Python program to perform Exploratory Data Analysis by displaying dataset keys, number of rows and columns, feature names, and dataset description.
4. *Data Preprocessing for Cyber Security Datasets*
   Perform data preprocessing techniques such as handling missing values, normalization, encoding categorical data, and splitting datasets for training and testing.