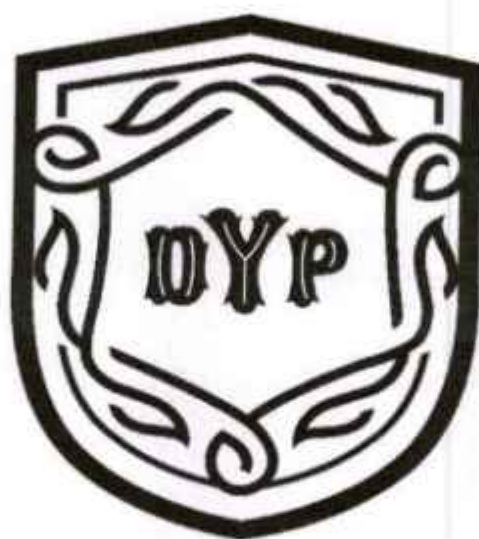# D. Y. Patil College of Engineering & Technology,

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

Accredited by NAAC with 'A' Grade

Structure & Syllabus

for

Third Year B. Tech

of

Computer Science & Engineering (Data Science)

(With effect from 2025-26)

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR

Teaching and Evaluation Scheme from Year 2025-26 (as per NEP-2020)

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

SEMESTER - V

Sr. No	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical/ Tutorial		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	231DSPCCL301	PCC	Operating Systems & Computer Networks	3	3	-	-	20	30	50	-	-	100
2	231DSPCCL302	PCC	Software Engineering	2	2	-	-	-	-	50	-	-	50
3	231DSPCCL303	PCC	Data Analysis and Visualization using R	3	3	-	-	20	30	50	-	-	100
4	231DSPCCP304	PCC	Data Analysis and Visualization using R Laboratory	1	-	2	-	-	-	-	25	25	50
5	231DSPCCP305	PCC	Programming Lab - III	3	2	2	-	-	-	-	50	50	100
6	231DSMDML301	MDM-III $	Methodology of Data Analytics using Deep Learning	4	3	2	-	20	30	50	25	-	125
7	231DSPECL301	PEC-I	Information Security	4	3	-	1	20	30	50	25	-	125
8	231DSPECL302		Data Engineering										
9	231DSPECL303		Object Oriented Modeling & Design										
10	231DSOECL301	OEC-III	Business Analysis using Python	2	2	-	-	-	-	50	-	-	50
11	231DSCCA301	CCA	Liberal Learning	-	-	2*	-	-	-	-	50*	-	Grade
12	231DSMCL301	MC	Finishing School Training - V	-	3*	-	--	-	-	-	50*	-	Grade
			Total	**22**	**18**	**06**	**01**	**80**	**120**	**300**	**125**	**75**	**700**

$ - Open & Distance Learning   * - Values are not included in total   **Min. Marks for Passing:** 40% of total marks of individual course

Program Coordinator   HOD CSE(Data Science)   Dean Academics   Principal

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR

Teaching and Evaluation Scheme from Year 2025-26 (as per NEP-2020)

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

SEMESTER - VI

Sr. No	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical/ Tutorial		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	231DSPCCL306	PCC	Database Engineering	3	3	-	-	20	30	50	-	-	100
2	231DSPCCL307	PCC	Machine Learning	3	3	-	-	20	30	50	-	-	100
3	231DSPCCP308	PCC	Database Engineering Laboratory	1	-	2	-	-	-	-	25	25	50
4	231DSPCCP309	PCC	Machine Learning Laboratory	1	-	2	-	-	-	-	25	-	25
5	231DSPCCP310	PCC	Data Analytical Tools - I	2	1	2	-	-	-	-	25	25	50
6	231DSMDML302	MDM-IV	Fundamentals of Business Intelligence	2	2	-	-	-	-	50	-	-	50
7	231DSPECL304	PEC-II	Cyber Security and Forensics	4	3	-	1	20	30	50	25	-	125
8	231DSPECL305		Software Architecture										
9	231DSPECL306		Internet of Things										
10	231DSPECL307	PEC-III	Blockchain Technology	3	3	-	-	20	30	50	-	-	100
11	231DSPECL308		Cloud Computing										
12	231DSPECL309		High Performance Computing										
13	231DSPECP310	PEC-III	Blockchain Technology Laboratory	1	-	2	-	-	-	-	25	-	25
14	231DSPECP311		Cloud Computing Laboratory										
15	231DSPECP312		High Performance Computing Laboratory										
16	231DSVSECP301	VSEC	Web Application Development - II	2	1	2	-	-	-	-	25	25	50
17	231DSCCA302	CCA	Liberal Learning	-	-	2*	-	-	-	-	50*	-	Grade
18	231DSMCL302	MC	Finishing School Training - IV	-	3*	-	-	-	-	-	50*	-	Grade
			Total	22	16	10	01	80	120	250	150	75	675

Program Coordinator   HOD CSE(Data Science)   Dean Academics   Principal

Course Type Abbreviation	Course Type Definition
PCC	Professional Core Course
CEP/FP	Comm. Engg. Project/Field Project
MDM	Multi-Disciplinary Minor
VEC	Value Education Course
OEC	Open Elective Course
HSSM	Humanities Social Science & Management
MC	Mandatory Course
CCA	Co-Curricular Activities
AEC	Ability Enhancement Course
VSEC	Vocational Skills Enhancement Course

Abbreviations:

ISE: In Semester Evaluation

MSE: Mid Semester Evaluation

ESE: End Semester Evaluation

INT: Internal Evaluation

OE: Oral Examination

PoE: Practical Oral Examination

Semester – V

D. Y. Patil College of Engineering & Technology, Kolhapur

(An Autonomous Institute)

Third Year B. Tech CSE (Data Science)

Semester – V

Course Code: 231DSPCCL301

Course Name: Operating Systems & Computer Networks

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week	03	ISE: 20 Marks
Tutorials: 00 Hrs/Week		MSE: 30 Marks
Practicals: 00 Hrs/Week		ESE: 50 Marks

Course Description:

This course provides overview of fundamentals of both operating system and computer network. It covers introduction to components of operating system, process management, synchronization and scheduling. The second section covers fundamental concepts of Computer networks, data communication, network topologies, protocols, and various networking along with addressing schemes.

Course Objectives:

- ❖ To learn the basic concepts of Operating system, its design and services.
- ❖ To explore students to various process management and synchronization methods.
- ❖ To understand the term of deadlock, how to handle it, detect it and prevent and recover it.
- ❖ To understand layered architecture and basic networking protocols.
- ❖ To demonstrate IP addressing schemes as well as subnetting and supernetting techniques.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand the structure, functions and services of an operating system.
2. Describe the methods of process management, process synchronization and deadlocks.
3. Explain the importance of deadlock handling in Operating System.
4. Describe the concepts of Computer Networks, mechanism of data link layer, including error detection & correction.
5. Apply the concept of IP addressing with IPV4 and IPV6.
6. Describe routing techniques and algorithms to address the routing problems.

Prerequisites: Computer Fundamentals

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	2
2	3	2	-	-	-	-	-	-	-	-	-	1	1	-	2
3	3	2	3	2	-	-	-	-	-	-	-	1	1	-	2
4	3	3	-	-	-	-	-	-	-	-	-	1	2	-	2
5	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
6	3	2	-	-	-	-	-	-	-	-	-	1	2	-	2

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Course Contents

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Unit 1	Introduction	06 Hours

Role of operating system- user view and system view, Computer system organization and architecture, Operating system operations, process management and memory management, Kernel data structures, Computing environments, Operating system services, System calls and its types, Operating system structures.

Unit 2	Process Management & Scheduling	06 Hours

Process concept, Process scheduling and operations, Interprocess communication, Overview of multithreading, Multicore programming, Multithreading models, Basic concepts of process scheduling, Scheduling criteria, Scheduling algorithms.

Unit 3	Process synchronization and deadlock	06 Hours

Synchronization- Background, Critical section problem, Synchronization hardware, Mutex, Semaphore, Classic synchronization problems, Monitor,

Deadlocks – System model, Deadlock Characterization, Methods for handling deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery.

Unit 4	Introduction to Computer Network	06 Hours

Data Communications: Components of Data Communication, Data Representation, Data Flow, Network Topology, Categories of Network - LAN, MAN, WAN, The OSI Model, TCP/IP Protocol Suite, TCP/IP vs OSI Model.

Design issues in Data Link Layer: Services provided to network layer, Framing, Flow Control, Error Control, **Error Detection:** Parity, Checksum, Cyclic Redundancy Check (CRC), **Error Correction:** Hamming Code, Binary Convolutional Codes, LDPC Codes.

Unit 5	IPv4 Addressing	06 Hours

Introduction: Address Space, Notation, Range of addresses,

Classful Addressing: Classes and blocks, Two-level addressing, Three-level addressing, Supernetting, **Classless Addressing:** variable length block, Two-level addressing, Block allocation,

Delivery & Forwarding of IP Packets, **Routing:** Static & Dynamic, **IPv4:** Datagram, Fragmentation, Options, Checksum, IPv6: Packet format, Transition from IPv4 to IPv6, Comparison between IPv4 and IPv6.

Unit 6	Routing & Congestion Control	06 Hours

Routing: Introduction, Routing Algorithms & its types, Shortest Path Algorithm, Flooding, Link State Routing, Distance Vector Routing, Broadcast Routing.

Congestion Control: Congestion Control, Congestion Control Techniques, Congestion Control in Datagram Subnets - Choke packets, Load shedding, Jitter Control.

Textbooks:

1. "Operating system concept", Silberschatz, Galvin, Gagne, Wiley India, 8th edition. [Unit 1 - 3]
2. "TCP/IP protocol Suits", Behrouz A. Forouzen, Tata Mag. Hill, 4th Edition. [Unit 4 - 6]
3. "Computer Networks", Tanebaum, Pearson, 5th Edition [Unit 4]

Reference Books:

1. "Operating systems concepts and design", Milan Milenkovic, McGraw-Hill, 2nd edition.
2. "Operating Systems: Internals and Design Principles", William Stallings, Pearson, 7th edition.
3. "Modern Operating Systems", Andrew S. Tanenbaum, Pearson Education International, 4th edition.

4. "Operating System with case studies in UNIX", Achyut S. Godbole, Netware and Windows NT, TMGH.
5. "Computer Networks", Andrew S. Tanenbaum, PHI.
6. "Unix Networking Programming", W. Richard Stevens, PHI.

Useful Links:

1. https://archive.nptel.ac.in/courses/106/105/106105183/
2. https://www.geeksforgeeks.org/computer-network-tutorials/
3. https://nptel.ac.in/courses/106/105/106105214/#
4. https://nptel.ac.in/courses/106/102/106102132/

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPCCL302
Course Name: Software Engineering

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 02 Hrs/ Week	02	ISE: --
Tutorials: 00 Hrs/Week		MSE: --
Practicals: 00 Hrs/Week		ESE: 50 Marks

Course Description:

This course provides introduction to methodologies of software engineering and Software Development Life Cycle (SDLC). It also contains exposure to different tools and models which play important role in Software Development Life Cycle (SDLC).

Course Objectives:

❖ To make students to understand & apply the knowledge of software engineering discipline.

❖ To make students to gain the knowledge of phase wise execution of Software Development Life Cycle (SDLC).

❖ To make students to have practical understanding of various process models in the software industry according to software requirements.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the fundamental principles of Software Development Life Cycle and its role in the successful execution of software projects.
2. Describe the process of Software requirement analysis and to understand the role of Software Requirement Specification document.
3. Understand the principles of Software Project Management & apply Capability Maturity Models (CMM) for process improvement and quality assurance.
4. Design and understand the process of implementation of software modules as per the desired specifications.

Prerequisites: Fundamentals of Programming Language

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	-	-	-	-	-	-	-	-	2	2	2	-	2
2	2	2	-	-	2	-	-	-	-	-	-	2	2	-	2
3	2	2	2	-	2	-	-	-	-	-	3	2	2	-	3
4	2	2	3	2	2	-	-	-	-	-	-	2	2	-	6

Course Contents

Unit 1	Introduction to Software & Processes	06 Hours

Software Problem- Cost, Schedule & Quality, Scale and change, Software Processes- Process and Project, Component Software Processes, SDLC, Software Development Process Modules, Project Management Process. Agile Development- XP, other Agile Process Models, Tool Set for Agile Process. Introduction to Requirements Engineering, Value of a good SRS, Requirement Process, Requirements Specifications, Other Approaches for Analysis, Validation.

Case study on Software requirements.

Unit 2	Software Planning & Risk Management	06 Hours

Responsibilities of Software Project Manager, Project Planning, Project Scheduling, Project Staffing, People CMM, Risk Management.

Case study on COCOMO.

Unit 3	Software Design	06 Hours

Basics of Software Design, Function Oriented Design - DFD, Object Oriented Design Class diagram, Sequence & collaboration diagram, Detailed Design.

Case Study for Software Design.

Unit 4	Coding & Testing	06 Hours

Features of Software Code, Coding Guidelines, Coding Methodology, Programming Practice, Code Verification Techniques, Coding Tools, Code Documentation, Software Testing Basics, Test plan, Test case Design, Software Testing Strategies, Level of Testing, Testing Techniques, Software testing Tools, Debugging, Software Test Report, and Introduction to Software deployment & Maintenance.

Case Study on Selenium open-source tool.

Textbooks:

1. "Software Engineering", Sommerville, (2016), 10th Edition, Pearson Education Limited. [Unit 1 - 6]
2. "Software Engineering: A Practitioner's Approach", Pressman, Roger S., Maxim, Bruce R. (2015), Mcgraw-Hill, 8th Edition.[Unit 1 – 6]

Reference Books:

1. "An integrated approach to Software Engineering", Pankaj Jalote, 3rd edition, Springer, 2005.
2. "The Essentials of Modern Software Engineering: Free the Practices from the Method Prisons", Ivar Jacobson, Harold Bud Lawson, Pan-Wei Ng, Paul E. McMahon and Michael Goedicke (2019), Morgan & Claypool Publishers
3. "Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices", Michael Jackson (1995), Addison-Wesley.

Useful Links:

1. https://nptel.ac.in/courses/106/105/106105182/
2. https://onlinecourses.nptel.ac.in/noc19_cs69/preview
3. https://www.mooc-list.com/course/software-engineering-introduction-edx

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPCCL303
Course Name: Data Analysis and Visualization using R

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 00 Hrs/Week	03	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks

Course Description:

The aim of the course is to provide basic knowledge about the fundamentals of data science and its processes. This course also aims to visualize the complex data using different data visualization tools using R programming. It also provides different statistical methods to perform data analysis.

Course Objectives:

- ❖ To learn about fundamentals of Data analytics and its application areas.
- ❖ To understand the use of R software and its fundamental concepts for data analytics.
- ❖ To be able to understand R Programming Decision making, functions, control statements & data structures.
- ❖ To be able to understand data visualization using R programming.
- ❖ To learn statistical methods and models for data analytics.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the fundamental concepts of R programming.
2. Illustrate the Data analytics, its types and applications.
3. Understand Exploratory Data Analysis techniques.
4. Apply the data aggregation technique and analyze the given dataset using techniques of correlation and time series analysis.
5. Apply the statistical computations for data analytics.
6. Apply different data visualization techniques on data from different sources.

Prerequisites: Programming Language

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	2	-	-	2	-	-	-	-	-	-	1	3	3	2
2	3	2	-	-	2	-	-	-	-	-	-	1	3	3	2
3	3	2	-	-	2	-	-	-	-	-	-	1	3	3	2
4	3	2	-	-	2	-	-	-	-	-	-	1	3	3	3
5	3	2	-	-	2	-	-	-	-	-	-	1	3	3	3
6	3	2	-	-	2	-	-	-	-	-	-	1	3	3	3

Course Contents

Unit 1	Basics of R Programming	06 Hours

Overview of R programming, Features of R, Applications of R, Introduction and Installation of R Studio, Creation and Execution of R File in R Studio, Clear the Console and the Environment in R Studio, Basic Syntax in R Programming, R Commands, Variables and scope of variables, Data Types, Operators, Keywords, Control Structures, Functions, R packages.
Data Structure in R: Array, Matrix, Vectors, Factors, Lists , Data frames.

Unit 2	Introduction to Data Science and Data Analysis	06 Hours

Data Science: What is Data Science, A Brief History, Difference between Data Science and Data Analytics, Knowledge and Skills for Data Science Professionals, Some Technologies used in Data Science, Benefits and uses of Data Science.
Data Analytics: Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics.

Unit 3	Exploratory Data Analysis Fundamentals	06 Hours

Understanding data science, Steps in EDA, Numerical data, categorical data, measurement scale, software tools for EDA, EDA with personal email-loading dataset, data transformation, data analysis.

Unit 4	Grouping Dataset	06 Hours

Grouping Dataset: Understanding groupby(), groupby mechanics, data aggregation-groupwise operation, groupwise transformation, pivot tables and cross tabulation.
Correlation and Time series analysis: Types of analysis, Multivariate analysis using Titanic dataset, Simpsons Paradox, correlation vs. causation, fundamentals of TSA, Characteristic of Time series data, TSA with Open Power System Data.

Unit 5	Statistics with R	06 Hours

Mean, Median and Mode, Variance and Standard Deviation, Descriptive Analysis, Normal Distribution, Binomial Distribution, Analysis of Variance (ANOVA) Test: One Way & Two Way ANOVA,
Regression: Linear and Multiple Linear Regression, Logistic Regression, Time Series Analysis, Survival Analysis.

Unit 6	Data Visualization using R	06 Hours

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.
Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts.

Textbooks:

1. "R for Everyone", Jared P Lander, Pearson Education 2017. [Unit 1,5,6]
2. "Beginning R: An Introduction to Statistical Programming", Larry Pace, Apress, 1st Edition.[Unit 5,6]
3. "Hands-On Exploratory Data Analysis with Python", Suresh Kumar Mukhiya, Usman Ahmed, Packt Publication.[Unit 2 – 4]

Reference Books:

1. "Introduction to statistical data analysis with R", Matthias Kohl, 1st edition (https://www.arma.org.au/wp-content/uploads/2017/03/introduction-to-statistical-data-analysis-with-r.pdf)
2. "Learning R: A Step-by-Step Function Guide to Data Analysis", Richard Cotton, O'Reilly

Useful Links:

1. https://www.geeksforgeeks.org/data-visualization-in-r/
2. https://www.coursera.org/learn/data-analysis-r

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPCCP304
Course Name: Data Analysis and Visualization using R Laboratory

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 02 Hrs/Week	01	INT: 25 Marks OE/POE: 25 Marks

Course Description:
The aim of the course is to provide practical knowledge about the data analytics using R programming. This course also aims to visualize the complex data using different data visualization tools. It also provides different statistical methods to perform data analysis.

Course Objectives:
❖ To understand fundamentals of R programming language.
❖ To gain knowledge of statistical computing.
❖ To analyze and visualize data using R programming language.

Course Outcomes:
On completion of the course, student will be able to:
1. Apply the fundamental concepts of R programming.
2. Apply different statistical methods for computing.
3. Analyze data using different techniques of R programming.

Prerequisites: Programming Language.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	3	3	2	3	-	-	2	-	-	-	2	3	3	3
2	3	3	3	2	3	-	-	2	-	-	-	2	3	3	3
3	3	3	3	2	3	-	-	2	-	-	-	2	3	3	4

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Installation of R and R Studio.	O	2
2	Demonstration of declaring R variables, objects, expressions, vectors and assigning values & Perform program for reading data from R and writing data into R.	O	2
3	Implementation of package in R & create a program for calling functions in R.	O	2

4	Perform various matrix operations &Implement the higher dimensional array in R.	O	2
5	Create list in R and perform various list operations to access list elements in R.	O	2
6	Create Data Frame in R & perform various operations on data frame & demonstrate the common functions on factors & tables in R.	O	2
7	Demonstration of plots in R as Box Plots, Pie Charts, Bar charts, Line Chart and histogram.	O	2
8	Study of Simple Liner Regression and Multiple Regression in R.	S	2
9	Perform program for reading/writing data from JSON file using R.	O	2
10	Import data using R and perform Mean, Median and Mode, Variance and Standard Deviation, Descriptive Analysis.	O	2
11	Implementation of descriptive statistics(variance, skewness, kurtosis, percentile).	O	2
12	Implementation of grouping and groupby.	O	2
13	Implementation of hypothesis testing-T Test.	O	2
14	Mini Project	O	2

S: Study   O: Operational

Textbooks:

1. "R for Data Science", Hadley Wickham and Garrett Grolemund, O'Reilly.
2. "Hands-On Programming with R", Garrett Grolemund, O'Reilly.
3. "Practical Data Science with R", Nina Zumel and John Mount, Manning.

Useful Links:

1. https://www.geeksforgeeks.org/data-visualization-in-r/
2. https://www.tpointtech.com/r-tutorial

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPCCP305
Course Name: Programming Lab - III

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 02 Hrs/ Week	03	INT: 50 Marks
Tutorials: 00 Hrs/Week		OE/POE: 50 Marks
Practicals: 02 Hrs/Week		

Course Description:

This course provides the object-oriented approach using Java programming constructs. The course includes basics of Java language programming, different object-oriented features, packages, file handling and multithreading.

Course Objectives:

- ❖ To introduce object-oriented concepts using JAVA programming constructs.
- ❖ To enhance real-world problem-solving approach using fundamental JAVA programming concepts like inheritance, interface, package, I/O and exception handling mechanisms.
- ❖ To build the foundations of advanced java programming for application development.

Course Outcomes:

On completion of the course, student will be able to:

1. Use the java programming concepts for solving the real-world problems with object-oriented approach.
2. Design and implement the reliable and user-friendly application using inheritance, interface, package, I/O and exception handling mechanisms.
3. Solve the problems using the concepts of multithreading and collections.

Prerequisites: Object Oriented Programming Language

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	3	3	3	-	-	2	-	-	-	2	2	-	6
2	3	3	3	3	3	-	-	2	-	-	-	2	2	-	6
3	3	3	3	3	3	-	-	2	-	-	-	2	2	-	6

Course Contents

Unit 1	Fundamental Programming in Java	06 Hours

The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Array.

Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class

Members, Static Fields and Methods, this keyword

Unit 2	**Inheritance and Polymorphism**	**05 Hours**

Definition, Super classes, and Subclasses, Overriding and Hiding Methods, Polymorphism and its types, Inheritance, Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Inner Classes, garbage collection.

Unit 3	**Interface, Package & Exception Handling**	**08 Hours**

Interfaces: Defining an Interface, implementing an Interface, using an Interface as a Type, Evolving Interfaces, and Default Methods.

Packages: Class importing, creating a Package, naming a Package, Using Package Members, Managing Source and Class Files.

Exception: Definition, dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, Re-throwing and Chaining Exceptions, finally clause.

I/O Streams: Byte Stream – Input Stream, Output Stream, Data Input Stream, Data Output Stream, File Input Stream, File Output Stream, Character Streams, Buffered Stream, Scanner class.

Unit 4	**Multithreading & Collections**	**05 Hours**

Multithreading: Processes and Threads, Runnable Interface and Thread Class, Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Thread States, Thread Properties

Collections: Collection Interfaces, Concrete Collections-List, Queue, Set, Map, the Collections Framework

Textbooks:

1. "JAVA-The Complete Reference", Herbert Schildt, Mcgraw Hill, Ninth edition.

Reference Books:

1. "Core Java- Volume I & II Fundamentals", Cay Horstmann and Gary Cornell, Pearson, Eight edition.

Useful Links:

1. https://www.geeksforgeeks.org/java/
2. https://www.tpointtech.com/java-tutorial

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Study of JAVA basics.	S	2
2	Write a program to perform different operations on 2*2 matrix. 1. Addition 2. Multiplication 3. Transpose	O	2

	Practice Programs –
	  1. Implement java program to find reverse of given number.
	  2. Implement java program to find factorial of given number.
	  3. Implement java program to check given number is prime or not. Take number using command line arguments.
		O	2

3	Implement java to print the area of a rectangle by creating a class named 'Area' having two methods. First method named as 'setDim' takes length and breadth of rectangle as parameters and the second method named as 'getArea' returns the area of the rectangle. Length and breadth of	O	2

		rectangle are entered through keyboard using scanner class.		
4		Write a Java Program to demonstrate the use of static variable, static block and static method.	O	2
5		Create a class called Employee that includes three pieces of information as instance variables i.e first name, a last name and a monthly salary. Your class should have a constructor that initializes the company name.Provide a set and a get method.Create two Employee objects and display each object's yearly salary. Then give each Employee a 10% raise and display each Employee's yearly salary again.	O	2
6		Write a Java program for single inheritance. Create class Person having variables Name, Aadhar No. Create another class Employee inherited from class Person having variable Salary and method Put data that displays all the data.	O	2
7		Write a java program for Hierarchical inheritance. Create a class Bank having method getInterestRate. Create classes Axis, HDFC, SBI extended from class bank and returns Interest rates respectively.	O	2
8		Write a java program for Multilevel inheritance. (Doctor, Orthopedic Doctor, Knee Specialist)	O	2
9		Write a java program for Function Overloading. Write different forms of addition method for addition of numbers(int,float,double) by function overloading.	O	2
10		Write a java program for Function Overriding. Create class bike having start method. Create classes splendor and scooty having run method overridden. Splendor will have kick start functionality whereas the scooty has Button Start functionality.	O	2
11		Create abstract class shape with dim1, dim2 variables and abstract area() method. Class rectangle and triangle inherits shape class. Calculate area of rectangle and triangle.	O	2
12		Create interface shape area() method. Class rectangle and triangle inherits shape class. Calculate area of rectangle and triangle.	O	2
13		Create two interfaces manual and auto having methods manualstart() and autostart(). Create class splender which implements interface manual. Create class scooty which implements the interface manual and auto. Display the output of these methods.	O	2
14		Class student with variable rollno, getrollno(), setrollno() methods. Class test inherits student class and have variables sub1, sub2 and getmarks(), setmarks() methods. Interface sports with variable smarks and set() method. Class result inherits test class and an implements sport interface and displays that marks.	O	2

15	Develop a mathematical package for Statistical operations like factorial, cube. Create a sub package in the math package -convert. In "convert" package provide classes to convert decimal to octal, binary, hex and vice-versa.	O	2	
16	Develop a package Operation consisting Addition class to perform addition of two numbers. Create class test and use the package addition to get addition of two numbers.	O	2	
17	Develop a package Operations consisting classes addition, subtraction, multiply, divide to provide the respective functionality. Create class test and use the package Operations to perform various operations on two numbers.	O	2	
18	Develop a BankAccount class which should contain all methods of Bank i.e. balanceEnquiry(), withdraw() and deposit(). Generate user defined exception LowBalanceException whenever required. Develop application program to use this user defined exception.	O	2	
19	Develop a java program to handle the Arithmetic Exceptions.	O	2	
20	Write a Java program to read text file and display its contents.	O	2	
21	Take file name as input to your program through command line. If file exists, then open it and display contents of the file. After displaying contents of file ask user – do you want to add the data at the end of file. If user response is "Yes", then accept data from user and append it to file. If file in not existing, then create a fresh new-file and store user data into it. Do this program to get the above specified output using IO operations in Java.	O	2	

S: Study   O: Operational

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSMDML301
Course Name: Methodology of Data Analytics using Deep Learning

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week	04	ISE: 20 Marks
Tutorials: 00 Hrs/Week		MSE: 30 Marks
Practicals: 02 Hrs/Week		ESE: 50 Marks
		INT: 25 Marks

Course Description:

This course provides an introduction to deep learning, neural networks, Convolutional neural networks, natural language processing using RNNs. This course comprehends introduction to deep learning concepts, including data manipulation, model building, optimization, and transfer learning.

Course Objectives:

- ❖ To understand deep learning concepts and perceptron learning algorithms.
- ❖ To understand neural networks, CNNs for image processing, and NLP techniques with RNNs.
- ❖ To explore deep reinforcement learning and unsupervised learning methods.
- ❖ To understand generative modeling for text and image generation.

Course Outcomes:

On completion of the course, student will be able to:

1. Describe the fundamental concepts of deep learning and perceptron learning algorithms.
2. Elaborate the fundamentals of neural networks for image processing.
3. Explain Convolutional Neural Networks (CNNs) for advanced image analysis techniques.
4. Interpret the basics of Recurrent Neural Networks (RNNs) & its applications.
5. Describe deep reinforcement learning and unsupervised learning methods for decision-making.
6. Understand the concepts of generative deep learning.

Prerequisites: Introduction to Machine Learning

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	-	-	-	-	-	-	-	1	2	-	2
2	2	2	2	2	-	-	-	-	-	-	-	1	2	-	2
3	2	2	-	-	-	-	-	-	-	-	-	1	2	-	2
4	2	2	-	-	-	-	-	-	-	-	-	1	2	-	2
5	2	2	-	-	-	-	-	-	-	-	-	1	2	-	2
6	2	2	-	-	-	-	-	-	-	-	-	1	2	-	2

Course Contents

Unit 1	Deep Learning Concepts	06 Hours

Fundamentals about Deep Learning, Perceptron Learning Algorithms, Probabilistic modelling, Early Neural Networks, How Deep Learning different from Machine Learning, Scalars, Vectors, Matrices, Higher Dimensional Tensors, Manipulating Tensors, Vector Data, Time Series Data, Image Data, Video Data.

Unit 2	Neural Networks	06 Hours

About Neural Network, Building Blocks of Neural Network, Optimizer, Activation Functions, Loss Functions, Data preprocessing for neural networks, Feature Engineering, Over fitting and Under Fitting, Hyper parameters.

Unit 3	Introduction to Convolutional Neural Network	06 Hours

Introduction to CNN and LTI Systems, Image Processing Filtering: Convolution, Edge Detection, Blurring, Sharpening, building a CNN: Input Layers, Convolution Layers, Pooling Layers, Dense Layers,
Back propagation in Convolutional Layers: Gradients and Weight Updates, Filters and Feature Maps: Extraction and Visualization.

Unit 4	Introduction to Recurrent Neural Networks	06 Hours

Overview of Recurrent Neural Networks (RNNs) and their applications, Key differences between RNNs and feed-forward neural networks,
RNN Architecture: Recurrent connection and hidden state, Back propagation Through Time (BPTT) algorithm for training RNNs.
Introduction to Long Short-Term Memory (LSTM) units: Architecture, components, and advantages in capturing long-term dependencies.
Bidirectional RNNs (BRNN): Benefits, architecture, and training for capturing context from both past and future inputs.

Unit 5	Deep Reinforcement & Unsupervised Learning	06 Hours

About Deep Reinforcement Learning, Q-Learning, Deep Q-Network (DQN), Policy Gradient Methods, Actor-Critic Algorithm, Auto encoding, Convolutional Auto Encoding, Variation Auto Encoding, Auto encoder for Feature Extraction, Auto Encoders for Classification, Denoising Auto encoder, Sparse Auto encoder.

Unit 6	Generative Deep Learning	06 Hours

Text generation with LSTM, Deep Dream, Neural Style Transfer, Generating images with variation auto encoders, Introduction to generative adversarial network.

Textbooks:

1. "Deep Learning A Practitioner's Approach", Josh Patterson and Adam Gibson, O'Reilly Media, Inc.2017 [Unit 1].
2. "Deep Learning", Ian Good fellow, Yoshua Bengio, Aaron Courvil, MIT Press Book [Unit 2, 3].
3. "Deep Learning with Python", François Chollet, Manning shelter [Unit 4, 5].
4. "Deep Learning", David FosterGenerative, O'Reilly Media 2019 [Unit 6].

Reference Books:

1. "Learn Keras for Deep Neural Networks", Jojo Moolayil, Apress,2018.
2. "Deep Learning with TensorFlow", Santanu Pattana yak, Apress,2017.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc24_cs114/preview
2. https://livebook.manning.com/book/machine-learning-in-action/about-this-book/
3. https://www.coursera.org/learn/deep-learning
4. https://nptel.ac.in/courses/deeplearnning

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Installation of Anaconda or Miniconda and working with TensorFlow and Keras	O	2
2	Introduction and working with Google Colab for using GPUs and TPUs for large projects	O	2
3	Implement a perceptron algorithm to classify a linearly separable dataset.	O	2
4	Build a feed forward neural network using a deep learning framework and train it to classify images from the MNIST dataset.	O	2
5	Compare the performance of different activation functions (e.g., ReLU, sigmoid) on a classification task using a neural network.	O	2
6	Experiment with various optimization algorithms (e.g., stochastic gradient descent, Adam) and observe their impact on model convergence.	O	2
7	Develop a convolution neural network (CNN) to classify images from the CIFAR-10 dataset and evaluate its accuracy.	O	2
8	Apply data augmentation techniques, such as rotation and horizontal flipping, to enhance the performance of a CNN on an image classification task.	O	2
9	Fine-tune a pre-trained CNN model (e.g., VGG16) on a different dataset and measure its transfer learning capabilities.	O	2
10	Build a recurrent neural network (RNN) with LSTM cells to generate text based on a given input sequence.	O	2

S: Study   O: Operational

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPECL301
Course Name: Information Security

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 01 Hrs/Week Practicals: 00 Hrs/Week	04	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks INT: 25 Marks

Course Description:

This course aims to explore information security through some introductory contents, defining the key terms, explaining essential concepts and goes through a review of the origins of the field. It presents several legal and ethical issues that are commonly found in today's organizations. The key topics explored include cryptography, access control, protocols, software, software security, OS security, data security and Software Vulnerabilities.

Course Objectives:

❖ To introduce the principles, components of information security, legal & ethical issues.
❖ To expose students to various cipher techniques and cryptographic algorithms, tools.
❖ To understand ways to provide access control like authorization and authentication.
❖ To make the students to understand working of security protocols.
❖ To analyze the security provisions in software, operating system and data.
❖ To make students to explore non-cryptographic and software vulnerabilities.

Course Outcomes:

On completion of the course, student will be able to:

1. Describe the major components of information security, security model, legal and ethical issues.
2. Apply cipher techniques, different cryptographic algorithms and tools.
3. Classify the working of various real-world security protocols.
4. Describe different access control mechanisms using authorization and authentication.
5. Analyze the security provisions in software, operating system and data.
6. Explore newer vulnerabilities and provide to take precautionary measures.

Prerequisites: Computer Networks

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	-	-	-	2	-	-	-	2	1	-	2
2	2	2	2	-	-	-	-	2	-	-	-	2	1	-	3
3	2	2	2	-	-	-	-	2	-	-	-	2	1	-	2
4	2	2	2	-	-	-	-	2	-	-	-	2	1	-	2
5	2	2	2	-	-	-	-	2	-	-	-	2	1	-	2

6	2	2	2	-	-	-	-	2	-	-	-	2	1	-	2

Course Contents

Unit 1	Introduction to Information Security	06 Hours

Introduction: Components of an Information System, The Security Systems Development Life Cycle, Information Security: The Need for Security, Legal, Ethical and Professional Issues.
Cryptosystems: Foundations of Cryptology, The OSI Security Architecture, Principles of Public-Key Cryptosystems, Attacks on Cryptosystems.

Unit 2	Cryptography	06 Hours

Symmetric Cipher Models: Substitution Techniques, Transposition Techniques, Block Cipher Principles, The Data Encryption Standard, Advanced Encryption Standard.
Cryptographic Algorithms-The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, MAC and Hash functions and their requirements.

Unit 3	Security Protocols	06 Hours

Simple Security Protocols, Authentication Protocols, Digital Signature, Digital Signature Standard, Authentication applications - Kerberos, X.509 Authentication service. Email Security - PGP, S/MIME, IP Security - IP Security Architecture, Authentication, Header and Encapsulating Security Payload.

Unit 4	Access Control: Authentication & Authorization	06 Hours

Authentication Methods, Passwords, Biometrics, Two-Factor Authentication, Single Sign- On and Web Cookies, Authorization, Access Control Matrix, CAPTCHA, Firewalls, Intrusion Detection Systems. Web and System Security - Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 5	Security in Software, Operating System and Data Security	06 Hours

Software Flaws and malware, Insecurity in Software: Software, Reverse Engineering, Digital Rights Management, Software Development. Operating Systems and Security: OS Security Functions, Trusted Operating System, Next Generation Secure Computing Base, Introduction to data Protection by patents, copyrights and trademarks, IT security acts.

Unit 6	Key cybersecurity compliance & Vulnerabilities	06 Hours

Key cybersecurity compliance and industry Standards-Introduction to GTA, Zero Trust architecture.
Software Security Software Vulnerabilities: Buffer Overflow, Salami Attack, Format string, cross-site scripting, SQL injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	The Role of Information Security in a Banking System	S	1
2	Cryptosystem Attack on an E-Commerce Platform	S	1
3	Implementing AES Encryption in Healthcare Systems	S	1
4	RSA and Diffie-Hellman in Secure Online Transactions	S	1
5	Implementing Kerberos for Secure Authentication in a Corporate Network	S	1
6	Digital Signatures and Email Security Using PGP and S/MIME	S	1
7	Implementing Two-Factor Authentication for Online Banking Security	S	1

8	Web Security in E-Commerce Using SSL/TLS and Secure Electronic Transactions (SET)	S	1	
9	The Impact of Software Flaws and Malware on Enterprise Security	S	1	
10	The Impact of Software Vulnerabilities and Malware Attacks on E-Commerce	S	1	

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Textbooks:

1. "Principles of Information Security", Michael E. Whitman and Herbert J. Mattord, Course Technology Cengage Learning, Fourth Edition.
2. "Information Security Principles and Practice", Mark Stamp, John Wiley & Sons Publications, Second Edition.

Reference Books:

1. "Cryptography and Network Security", Atul Kahate, TMGH, Third Edition.
2. "Cryptography and Network Security Principles and Practices", Williams Stallings, Pearson Education (LPE), Seventh Edition.

Useful Links:

1. https://nptel.ac.in/courses/106106129

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPECL302
Course Name: Data Engineering

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 01 Hrs/Week Practicals: 00 Hrs/Week	04	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks INT: 25 Marks

Course Description:

This course is about the understanding of fundamental techniques involved in the data engineering and will provide understanding of data engineering life cycle. Also, includes topics which focus on source systems of data engineering, storage, ingestion, Security, data Management, Data modelling and Design. They are used in a variety of applications today including Business Intelligence and Analytics, smart cities, healthcare, fraud detection.

Course Objectives:

- ❖ To make students to learn the basic principles, foundation and building blocks of Data Engineering.
- ❖ To understand the data engineering lifecycle and ETL model.
- ❖ To understand the need of basic architecture in data engineering.

Course Outcomes:

On completion of the course, student will be able to:

1. Describe the basic principles, foundation and building blocks of Data Engineering.
2. Define the data engineering lifecycle and ETL model.
3. Explain the need of basic architecture in data engineering.
4. Summarize the technologies used for implementation of data engineering lifecycle.
5. Understand the foundational principles of serving data for analytics and machine learning.
6. Describe security, privacy practices, and future trends in data engineering.

Prerequisites: Data Structure

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2
2	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2
3	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2
4	3	3	-	-	-	-	-	-	-	-	-	2	2	2	2
5	3	2	-	-	-	-	-	-	-	-	-	2	2	2	2
6	3	2	-	-	2	-	-	-	-	-	-	2	2	2	2

Course Contents

Unit 1	Foundation and Building Blocks of Data Engineering	06 Hours

What is Data Engineering - Data Engineering Defined, Data Engineering Lifecycle, Evolution of the Data Engineer, Data Engineering and Data Science.

Data Engineering Skills and Activities - Data Maturity and the Data Engineer, The Background and Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities.

Data Engineers Inside an Organization - Internal-Facing Versus External-Facing Data Engineers, Data Engineers and Other Technical Roles, Data Engineers and Business Leadership.

Unit 2	The Data Engineering Life Cycle	06 Hours

What is data engineering life cycle - The data lifecycle vs the data engineering lifecycle, source systems, storage, ingestion, Batch vs streaming, push vs pull, Transformation, serving Data, Analytics, Machine Learning, Reverse ETL.

Major undercurrents across the Data Engineering Lifecycle - Security, data Management, Data modelling and Design, Data Lineage, Data Integration and interoperability, Data Lifecycle management, DataOps

Unit 3	Designing good data architecture	06 Hours

What is data architecture, enterprise architecture, Good data architecture, principles of good data architecture, Major architecture concepts, tight vs loose coupling, examples and types of Data architecture.

Unit 4	Choosing technologies across Data Engineering Lifecycle	06 Hours

Team size and capabilities, Speed to market, Interoperability, Cost optimization and business value, Today versus the future: immutable versus transitory technologies, Location (cloud, on premises, hybrid cloud, multi cloud), Build versus buy, Monolith versus modular, Server less versus servers, Optimization, performance and the benchmark wars, The undercurrents of the data engineering lifecycle

Unit 5	Serving Data for Analytics, Machine Learning, and Reverse ETL	05 Hours

General Considerations for Serving Data, Analytics, Machine Learning, What a Data Engineer Should Know About ML, Ways to Serve Data for Analytics and ML, Reverse ETL.

Unit 6	Security, Privacy, and the Future of Data Engineering	07 Hours

Human Factors, Processes, Technology and Infrastructure, The Future of Data Engineering: The Enduring Nature of the Data Engineering Lifecycle, Evolving Job Roles and Responsibilities, Transition from the Modern Data Stack to the Live Data Stack, Emerging Trends in data engineering.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	Define Data Engineering and explain how it is different from Data Science.	S	1
2	List the skills of a Data Engineer and describe their business and technical responsibilities.	S	1
3	Explain the role of Data Engineers in a company, and how they work with other teams.	S	1
4	Draw and label the Data Engineering Lifecycle, showing key stages like ingestion, transformation, and serving.	S	1

5	Discuss the key challenges in the Data Engineering Lifecycle, such as data security, integration, and DataOps.		S	1
6	Explain what makes a good data architecture, and give examples of different types of data architecture.		S	1
7	Compare tight and loose coupling in data systems and explain when to use each.		S	1
8	List the factors to consider when choosing data tools, such as team size, cost, and future needs.		S	1
9	Compare cloud, on-premises, and hybrid systems, and list their pros and cons.		S	1
10	Describe how data is served for analytics and machine learning, and explain what reverse ETL means.		S	1
11	List common data security practices, such as encryption, backups, and access control.		S	1
12	Discuss the future of Data Engineering, including new tools, trends, and changing job roles.		S	1

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Textbooks:

1. Fundamentals of Data Engineering, Joe Reis &Matt Housley, O'REILLY. [Unit 1 to 6]

Reference Books:

1. Designing Data-Intensive Applications, Martin Kleppmann, O'REILLY
2. Data Engineering with Python, Paul Crickard, Packt Publication

Useful Links:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-data-engineering-usingazure/?v=c86ee0d9d7ed
2. https://www.coursera.org/specializations/data-engineering-foundations

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSPECL303
Course Name: Object Oriented Modeling & Design

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 01 Hrs/Week Practicals: 00 Hrs/Week	04	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks INT: 25 Marks

Course Description:

This course provides introduction to the fundamental principles and practices of object-oriented modeling and design. It covers design approach using Unified Modelling language based on core object-oriented concepts such as classes, objects, inheritance, polymorphism, encapsulation, and abstraction.

Course Objectives:

❖ To learn about modeling concept & create class models using object oriented principles.
❖ To understand advanced class modeling techniques and how to represent object behavior using state modeling.
❖ To be able to understand how to model the structural aspects of software systems using UML diagrams.
❖ To be able to understand UML notations to model the dynamic aspects of system.
❖ To learn the basic stages of software development, focusing on system ideas, domain analysis, and building simple models.
❖ To be able to understand architectural modeling by focusing on components and deployment diagrams.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the fundamentals principles of object oriented modeling & design.
2. Design the solution for given problem statement using advanced class modeling & state modeling.
3. Make use of basic Unified Modeling Language to design the solution of any real time problem.
4. Design the dynamic behavioral modeling using different design techniques.
5. Demonstrate the ability to build simple models using system ideas and domain analysis.
6. Design the architectural modeling by focusing on components and deployment diagrams.

Prerequisites: Object Oriented Concepts

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	-	-	-	-	-	-	-	-	2	2	2	-	2
2	2	2	-	-	2	-	-	-	-	-	-	2	2	-	2
3	2	2	2	-	2	-	-	-	-	-	3	2	2	-	3
4	2	2	3	2	2	-	-	-	-	-	-	2	2	-	6
5	2	2	2	2	2	-	-	-	-	-	1	2	2	-	6

6	2	2	2	-	2	-	-	1	-	-	-	2	2	-	2

Course Contents

Unit 1	Introduction, Modeling Concepts, Class Modeling	06 Hours

What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history. Modeling as Design Technique: Modeling; abstraction, The three models. Class Modeling: Object and class concepts; Link and associations concepts, Generalization and inheritance, A sample class model; Navigation of class models

Unit 2	Advanced Class Modeling & State Modeling	06 Hours

Advanced object and class concepts; Association ends, Aggregation; Abstract classes; Multiple inheritance, Metadata Reification; Constraints, Derived data; Packages.
State Modeling: Events, States, Transitions and Conditions, State diagrams; State diagram behavior

Unit 3	Introducing the UML	06 Hours

An overview of the UML, Conceptual Model of UML, Architecture of UML
Structure modeling Using UML: Classes, Relationship, Diagrams, Class Diagrams.

Unit 4	Behavioral Modeling	06 Hours

Interactions, Use Cases, Use Case Diagram, Interaction diagrams, Activity diagrams, Events & Signals, State Machines, Time & Space, State chart diagrams.

Unit 5	Process Overview, System Conception, Domain Analysis	06 Hours

Process Overview: Development stages, Development life cycle. System Conception: Devising a system concept Elaborating a concept, Preparing a problem statement. Domain Analysis: Overview of analysis, Domain class model, Domain state model, Domain interaction model, Iterating the analysis

Unit 6	Architectural Modeling	06 Hours

Components, Deployment, Collaboration, Patterns & frameworks, component diagrams, Deployment diagrams.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	Introduction to Object Orientation and OO Development Concepts	S	1
2	Exploring OO Themes and the Benefits of OO Development	S	1
3	Understanding Modeling, Abstraction, and the Three Model Types	S	1
4	Fundamentals of Class Modeling: Objects, Classes, and Associations	S	1
5	Inheritance, Generalization, and Navigating Class Models	S	1
6	Advanced Class Modeling: Aggregation, Abstract Classes, and Multiple Inheritance	S	1
7	Metadata, Constraints, and Packaging in Class Models	S	1
8	Introduction to State Modeling: Events, States, and Transitions	S	1
9	Overview and Architecture of UML and Structure Modeling	S	1
10	Behavioral Modeling: Use Cases, Interactions, and Activity Diagrams	S	1

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Textbooks:

1. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2 nd Edition, Pearson Education, 2005.
2. The Unified Modeling Language User Guid, Grady Booch, James Rambaugh, Lvar Jacobson, Addison Wesley

Reference Books:

1. Object oriented analysis & design using UML, H. Srimathi, H. Sriram, A. Krishnamoorthy, SCITECH PUBLICATION 2nd Edition
2. Object Oriented analysis& Design, Andrew High, TMG

Useful Links:

1. https://www.geeksforgeeks.org/types-of-models-in-object-oriented-modeling-and-design/

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSOECL301
Course Name: Business Analysis using Python

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 02 Hrs/ Week	02	ISE: --
Tutorials: 00 Hrs/Week		MSE: --
Practicals: 00 Hrs/Week		ESE: 50 Marks

Course Description:

This course provides introduction business analysis techniques using Python programming language. It includes business data analysis and tasks like data cleaning, manipulation, statistical analysis, visualization to extract actionable insights. It empowers business analysts to work with data more effectively using Python's powerful libraries like Pandas, NumPy, and Matplotlib.

Course Objectives:

- ❖ To understand the fundamentals of business analysis.
- ❖ To understand the use of Python libraries such as Pandas, NumPy, and Matplotlib for data manipulation, analysis, and visualization.
- ❖ To understand data cleaning, transformation, and descriptive statistics to extract insights from business data.

Course Outcomes:

On completion of the course, student will be able to:

1. Describe the Business Analysis concepts like data-driven decision-making, key business metrics, and problem-solving strategies.
2. Understand the use of Python libraries such as Pandas, NumPy, and Matplotlib for data manipulation, analysis, and visualization.
3. Illustrate the data preprocessing techniques to handle missing data, outliers, inconsistencies and transformation.
4. Describe the Exploratory Data Analysis concepts.

Prerequisites: Data Science for Everyone, Python Programming Language

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	2	2	2	2	-	-	1	-	-	-	1	2	2	2
2	3	3	2	2	2	-	-	1	-	-	-	1	2	2	2
3	3	3	2	2	2	-	-	1	-	-	-	1	2	2	2
4	3	2	2	2	2	-	-	1	-	-	-	1	2	2	2

Course Contents

Unit 1	Introduction to Data Analytics	06 Hours

Overview of Data Analytics: Definition of Data Analytics, Importance in decision-making and business intelligence, Types of data analytics: Descriptive, Diagnostic, Predictive, and Prescriptive.

Python for Data Analytics: Python installation and setup, Introduction to Python Integrated Development Environments (IDEs), Basics of Python programming (variables, data types, loops, and functions)

Unit 2	Data Handling and Manipulation with Python	06 Hours

Working with Python Libraries: Introduction to key libraries: pandas, numpy, matplotlib, seaborn, scikit-learn.

Data Structures: Lists, tuples, sets, dictionaries, and arrays (using numpy)

DataFrames with Pandas: Creating, viewing, and manipulating DataFrames, Indexing, filtering, and selecting data, Handling missing data (NaN values) and duplicate entries, Data types and conversions

Unit 3	Data Cleaning and Preprocessing	06 Hours

Data Cleaning: Handling missing values (imputation, removal), Removing outliers and duplicates, Formatting and transforming data (e.g., converting date/time formats).

Data Transformation: Normalization and standardization, Feature encoding (e.g., one-hot encoding for categorical data).

Merging, Joining, and Concatenating DataFrames: Combining data from multiple sources.

Unit 4	Exploratory Data Analysis	06 Hours

Statistical Analysis: Descriptive statistics (mean, median, mode, variance, etc.), Probability distributions (normal, binomial, Poisson).

Visualization: Data visualization with matplotlib and seaborn, Histograms, bar charts, scatter plots, box plots, heatmaps, creating basic charts (line, bar, histogram, scatter), Customizing charts (titles, labels, legends), Correlation analysis using pair plots and correlation matrices.

Textbooks:

1. "Python for Data Analysis", Wes McKinney, O'Reilly, 3rd Edition
2. "Data Analytics with Python: A Step-by-Step Guide to Manipulating, Analyzing, and Visualizing Data with Python", Chantal D. P. van Gerven.

Reference Books:

1. "Data Analytics Made Accessible", Anil Maheshwari.
2. "Learning Python for Data Analysis and Visualization", Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, and Abhijit Dasgupta.
3. "Hands-On Data Analysis with Pandas: Get to grips with data analysis using pandas and other Python libraries", Stefanie Molin.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc24_cs65/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg11/preview

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – V
Course Code: 231DSCCA301
Course Name: Liberal Learning

Teaching Scheme:	Audit Course	Evaluation Scheme:
Lectures: 00 Hrs/ Week		Grade Based Evaluation
Tutorials: 00 Hrs/Week		
Practicals: 02 Hrs/Week		

Course Description & Objectives:

The basic objective of this grading based audit course is to enhance the diversified & multidisciplinary learning attitude among the students. It is implemented through different institute & department level technical as well as non-technical clubs. At the starting of semester - III students will submit the preferences for different clubs available at institute as well as department. It is made mandatory for each student to enroll for minimum two clubs at each semester. The faculty incharge associated with particular club will evaluate the performance of students enrolled for that particular club. Based on the evaluation the grades will be given to each student. Each faculty incharge will prepare the schedule of activities conducted during that semester. It will be the responsibility of the concerned faculty incharge to plan, execute scheduled activities and evaluate the performance of each individual student enrolled for that particular club.

Course Outcomes:

On completion of the course, students will be able to –

1. Understand the various disciplines beyond their major which foster a well-rounded education.
2. Think critically and analytically to solve real world problems in day-to-day life.
3. Understand diverse cultures, perspectives, and traditions enriching the global awareness.
4. Adapt innovative ideas and information to prepare for lifelong learning beyond their formal education.
5. Communicate effectively with clear understanding of innovative ideas.
6. Cultivate personal and intellectual growth in the interdisciplinary thinking and problem-solving skills.

List of Clubs Available at Department:

1. Data Analytics Club:

Aim:

The primary aim of a Data Analytics Club is to create a collaborative and dynamic environment where students can enhance their knowledge, skills, and practical experience in data analytics. This involves fostering a community that promotes learning, innovation, and professional growth in the field of data analytics. The club seeks to bridge the gap between academic knowledge and real-world application, preparing members for successful careers in data analytics by providing resources, networking opportunities, and hands-on experiences.

Objectives:

- **Skill Development:**
  - Technical Skills: Provide training and workshops on data analytics tools and technologies such as Python, R, SQL, Tableau, Power BI, and machine learning.
  - Soft Skills: Enhance communication, teamwork, problem-solving, and project management skills through collaborative projects and presentations.

- **Knowledge Expansion:**
  - Guest Lectures: Invite industry professionals to speak about current trends, best practices, and real-world applications of data analytics.
  - Industry Trends: Keep members informed about the latest developments in data analytics, including new tools, techniques, and methodologies.

- **Hands-on Experience:**
  - Projects: Offer opportunities to work on real-world data projects, either individually or in teams, to apply theoretical knowledge in practical scenarios.
  - Competitions: Organize and participate in data analytics competitions and hackathons to foster a competitive and innovative spirit.

- **Networking:**
  - Industry Connections: Facilitate connections with professionals and alumni working in the field of data analytics.
  - Peer Networking: Create a community where students can collaborate, share knowledge, and support each other's learning journeys.

- **Career Preparation:**
  - Internship Opportunities: Provide information about internships and job openings in the field of data analytics.
  - Resume Building: Offer workshops on resume writing, LinkedIn profile optimization, and interview preparation specific to data analytics roles.

- **Research & Innovation:**
  - Research Projects: Encourage and support members in conducting research projects and publishing their findings in academic or industry journals.
  - Innovation: Foster a culture of innovation by encouraging members to explore new ideas and approaches in data analytics.

Outcomes:

- **Enhanced Skill Set:** Members will develop a strong foundation in data analytics tools and techniques, making them more competitive in the job market.
- **Practical Experience:** Participation in real-world projects and competitions will provide practical experience, helping members to apply theoretical knowledge in practical scenarios.
- **Professional Growth:** Networking opportunities with industry professionals and alumni will help members build valuable connections and gain insights into the industry.
- **Career Readiness:** Members will be better prepared for careers in data analytics through exposure to job opportunities, resume workshops, and interview preparation sessions.

- **Research Contributions:** Members will have opportunities to contribute to the field through research projects and publications.
- **Community Building:** The club will create a supportive community where students can share knowledge, collaborate on projects, and help each other grow.
- **Innovation and Creativity:** Members will be encouraged to think creatively and innovate, leading to new ideas and approaches in data analytics.
- **Increased Confidence:** Through presentations, workshops, and networking events, members will gain confidence in their abilities to communicate and apply data analytics concepts.

2. Rational Programmers Club:

Aim:

The primary aim of a Rational Programmers Club within the Data Science Department is to cultivate a community where students can enhance their coding skills, apply their knowledge to solve real-world problems, and prepare for careers in data science and related fields. The club seeks to create an environment that encourages continuous learning, collaboration, and innovation in coding, particularly as it applies to data science.

Objectives:

- **Skill Development:**
  - Programming Efficiency: Provide training in various programming languages commonly used in data science, such as Python, R, SQL, and Java.
  - Data Science Tools: Teach members how to use data science tools and libraries, such as pandas, NumPy, scikit-learn, TensorFlow, and more.
- **Practical Applications:**
  - Projects: Encourage members to participate in or initiate coding projects that solve real-world data science problems.
  - Hackathons: Organize and participate in hackathons and coding competitions to foster a spirit of innovation and problem-solving.
- **Knowledge Sharing:**
  - Workshops & Seminars: Conduct workshops, seminars, and coding boot camps to share knowledge and best practices in coding and data science.
  - Peer Learning: Promote peer-to-peer learning through study groups, code reviews, and collaborative projects.
- **Career Preparation:**
  - Portfolio Building: Help members build a portfolio of coding projects that demonstrate their skills and knowledge in data science.
  - Career Guidance: Provide guidance on career paths in data science, including resume building, interview preparation, and internship/job search strategies.
- **Networking:**
  - Industry Connections: Facilitate connections with data science professionals, alumni, and industry partners.

- Community Building: Create a supportive community where members can network, collaborate, and share resources.
  - **Innovation & Research:**
    - Cutting-edge Topics: Explore and work on cutting-edge topics in data science, such as machine learning, artificial intelligence, big data analytics, and more.
    Research Projects: Encourage members to participate in or initiate research projects and publish their findings.

Outcomes:

- **Enhanced Coding Skills:** Members will develop strong programming skills and a deep understanding of data science tools and techniques.
- **Practical Experience:** Participation in real-world projects and hackathons will provide hands-on experience, enabling members to apply their knowledge practically.
- **Professional Growth:** Networking with industry professionals and peers will help members build valuable connections and gain insights into the data science industry.
- **Career Readiness:** Members will be better prepared for careers in data science through portfolio building, resume workshops, and interview preparation sessions.
- **Community Contributions:** The club will create a collaborative community where members can share knowledge, support each other's learning, and contribute to the field of data science.
- **Innovation & Research Contributions:** Members will have opportunities to work on innovative projects and research, contributing to advancements in data science.
- **Increased Confidence:** Through coding challenges, presentations, and collaborative projects, members will gain confidence in their abilities to code and solve complex data science problems.
- **Lifelong Learning:** The club will instill a mindset of continuous learning and curiosity, encouraging members to stay updated with the latest developments in coding and data science.

Evaluation:

Evaluation of individual student will be carried out based on following criteria -

1. Knowledge & Understanding
2. Critical Thinking
3. Communication Skills
4. Ethical Reasoning
5. Cultural Awareness and Diversity
6. Interdisciplinary Connections
7. Creativity and Innovation
8. Collaboration and Teamwork

Semester – VI

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPCCL306
Course Name: Database Engineering

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 00 Hrs/Week	03	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks

Course Description:

This course introduces students to the fundamental concepts, principles and tools of database systems. The course includes relational data model and languages, database design techniques, SQL, data storage and indexing techniques. Also, the focus is given on concurrency control and recovery techniques.

Course Objectives:

- ❖ To develop conceptual understanding of fundamentals of database management systems.
- ❖ To get familiar with different data models.
- ❖ To model the database by query writing.
- ❖ To understand functional dependency and normalization.
- ❖ To expose students to transaction processing and concurrency control mechanisms.

Course Outcomes:

On completion of the course, student will be able to:

1. Design database using E-R Model.
2. Devise queries using SQL.
3. Describe functional dependency and different normalization forms.
4. Compare different indexing schemes.
5. List different concurrency control mechanisms.
6. Explain different deadlock handling and data recovery methods.

Prerequisites: Object Oriented Concepts, Data Structures

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	3	3	3	3	2	-	-	-	-	-	-	2	2	-	3
2	3	3	3	3	2	-	-	-	-	-	-	2	2	-	3
3	3	3	3	3	2	-	-	-	-	-	-	2	2	-	2
4	2	2	2	-	2	-	-	-	-	-	-	2	2	-	2
5	2	2	2	-	2	-	-	-	-	-	-	2	2	-	2
6	2	2	3	3	2	-	-	-	-	-	-	2	2	-	2

Course Contents

Unit 1	Introduction to Database Management System	08 Hours

Introduction, Database System Applications, Traditional File System v/s DBMS, Purpose of Database Systems, View of data, Instances and Schema, Data Models, Database Languages, Database Architecture,

Database Design Process, E-R Model, Constraints, Keys, E-R Diagrams, Reduction to Relational Schemas, Generalization, Specialization, Aggregation.

Unit 2	Structured Query Language	06 Hours

Introduction to SQL, data types, **DDL Statements:** Create, Alter, Drop, Rename, Truncate,

DML Statements: Insert, Update, Delete, **DQL Statement:** Select, **DCL Statements:** Grant, Revoke, **TCL statements:** Commit, Rollback, Save Point.

String Operations, Group by clause, having clause, order by clause, Set Operations, Aggregate functions, Nested Queries, Joins, Views.

Unit 3	Functional Dependency & Normalization	06 Hours

Integrity constraints: domain constraints, referential integrity, Functional dependency, types of functional dependency

Normalization: Purpose of normalization, First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF).

Unit 4	Data Storage and Indexing	06 Hours

Data Storage: Overview of physical storage media, RAID, File organization, Organization of records in file, Buffer Management.

Indexing: Ordered indices, primary indices, secondary indices, dense and sparse indices.

Hashing: Static hashing, open hashing, closed hashing, Dynamic hashing

Unit 5	Transaction Processing and Concurrency Control	05 Hours

Transaction Processing: Concept, ACID properties, Transaction model, Schedule, Serializability – conflict and view Serializability, Recoverable schedule.

Concurrency Control Mechanisms: Lock based protocols, Multiple Granularity, Timestamp based protocols, Validation based protocols.

Unit 6	Deadlock Handling and Data Recovery	05 Hours

Deadlock Handling: Deadlock prevention, deadlock detection and deadlock recovery.

Data Recovery: Failure Classification, Storage, Log based recovery, checkpoints, Shadow paging.

Textbooks:

1. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 6th edition, McGraw- Hill. [Unit 1 – 2]
2. "Database Systems - A Practical Approach to Design, Implementation and Management", Thomas Connolly, Carolyn Begg, 4th Edition, Addison Wesley. [Unit 4– 6]
3. "MySQL Cookbook", Paul DuBois, 3rd edition, O'REILLY. [Unit 3]

Reference Books:

1. "Fundamentals of Database Systems", Ramez, Elmasri, Shamkant B. Navathe, 6th Edition, Addison Wesley.
2. "Database Systems – Design, Implementation and Management", Rob & Coronel, 5th Edition, Thomson Course Technology.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview
2. https://onlinecourses.nptel.ac.in/noc25_cs40/preview

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPCCL307
Course Name: Machine Learning

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 00 Hrs/Week	03	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks

Course Description:

This course is an introduction to the theoretical aspects of design and implementation of algorithms that enables machines to "learn" from experience. The course will give the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work. The course will provide knowledge about Supervised and Unsupervised Machine Learning. Also it covers the core Machine Learning algorithms for classification, regression and clustering.

Course Objectives:

* ❖ To make students to understand basic terminology in machine learning.
* ❖ To make students to understand and implement different machine learning algorithms.
* ❖ To make students to describe regression and classification problems.
* ❖ To make students to understand clustering techniques.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand different concepts and terminologies in Machine Learning.
2. Apply the different regression techniques to solve the real-world problem.
3. Use different classification techniques to classify the multivariate data.
4. Illustrate the applications of Bayes theorem in machine learning.
5. Apply decision tree and SVM to solve classification problem.
6. Describe different clustering techniques.

Prerequisites: Linear algebra, Probability & Statistics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	-	-	-	-	-	-	-	2	3	3	2
2	2	2	2	2	-	-	-	-	-	-	-	2	3	3	3
3	2	2	2	2	-	-	-	-	-	-	-	2	3	3	2
4	2	2	2	2	-	-	-	-	-	-	-	2	3	3	2
5	2	2	2	2	-	-	-	-	-	-	-	2	3	3	3
6	2	2	2	2	-	-	-	-	-	-	-	2	3	3	2

Course Contents

Unit 1	Introduction to Machine Learning	06 Hours

Machine Learning: Definition, Working, Terminologies, Types of Machine Learning, Machine Learning Problem Categories, Machine Learning Lifecycle, Applications of Machine Learning.

Performance Measures in Machine Learning: Accuracy, Confusion Matrix, Precision, Recall, F-Score, AUC. Machine Learning Tools and frameworks, Data Visualization: Data Visualization Approaches, Use in Machine Learning, Challenges

Unit 2	Regression	06 Hours

Definition, Terminologies, Hypothesis, Types of Hypothesis, Cost Function, Use of Cost Function.
Linear Regression: Definition, Types, Assumptions, Hypothesis, Best Fit Line, Cost Function, Gradient Descent.
Multiple Linear Regression: Definition, assumptions, Variance, Covariance.
Multivariate Linear Regression: Definition, Feature Scaling, Standardization, Normalization, Steps of Multivariate Regression Analysis.

Unit 3	Classification	06 Hours

Logistic Regression: Definition, Need, Applications, Types, Terminologies, Sigmoid Function, Hypothesis, Decision Boundary, Working of Logistic Regression, Cost Function, Logistic Regression Modeling.
Regularization: Overfitting, Underfitting, Terminology, Definition, Regularization Techniques.
K-Nearest Neighbor (KNN): Definition, Working, Advantages, Disadvantages

Unit 4	Bayesian Learning	06 Hours

Bayes Theorem, Prerequisites for Bayes Theorem, Naïve Bayes Classifier, Working, Bayesian Belief Network, Hidden Markov Model (HMM), HMM Algorithm, Issues in Hidden Markov Model.

Unit 5	Decision Trees & Support Vector Machine	06 Hours

Decision Trees: Definition, Terminologies, Need, Decision Tree Algorithm, Examples, Attribute Selection Measures, Information Gain, Gini Index, Entropy, Types of Decision Trees, Applications, Pruning, Advantages, Disadvantages, Common Problems in Decision Tree.
Random Forest: Introduction, Assumptions, Need, Random Forest/ Algorithm, Advantages, Disadvantages.
Support Vector Machine (SVM): Terminology, Types, Working, SVM Kernels, Advantages, Disadvantages.

Unit 6	Clustering	06 Hours

Introduction, Types, Partitioning Clustering, Density-Based Clustering, Distribution Model-Based Clustering, Hierarchical Clustering, Fuzzy Clustering, Partitioning Methods, K-Means Clustering, K-Medoid Clustering, Hierarchical Methods of Clustering, Agglomerative Hierarchical Clustering, Divisive Clustering.

Textbooks:

1. "Machine learning", Anuradha Srinivasaghavan and Vincy Joseph, Kindle Edition, 2020, WILEY.
2. "Machine Learning - An Algorithmic Perspective", Stephen Marsland.

Reference Books:

1. "Machine Learning", Tom M. Mitchell, International Edition 1997, McGraw Hills Education

Useful Links:

1. http://livebook.manning.com/book/machine-learning-in-action/about-thisbook/
2. http://nptel.ac.in/courses/106106139
3. http://www.coursera.org/learn/machine-learning

	D. Y. Patil College of Engineering & Technology, Kolhapur (An Autonomous Institute) **Third Year B. Tech CSE (Data Science)** Semester – VI **Course Code: 231DSPCCP308** **Course Name: Database Engineering Laboratory**

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 02 Hrs/Week	01	INT: 25 Marks OE/POE: 25 Marks

Course Description:

The primary objective of this course is to provide hands-on experience with Database Management Systems such as MySQL. Students will learn how to design, implement, and manipulate databases using SQL and object-oriented programming techniques.

Course Objectives:

❖ To demonstrate fundamental concepts of database systems.

❖ To explore the Structured Query Language (SQL)

❖ To construct the database for a given application.

Course Outcomes:

On completion of the course, student will be able to:

1. To demonstrate fundamental concepts of database managements systems.
2. To model E-R diagrams and design database schema.
3. To formulate SQL queries to accurately represent real-world scenarios.

Prerequisites: Set Theory, Data Structures

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	1	1	1	3	-	-	-	1	-	-	1	3	2	3
2	3	2	2	1	3	-	-	-	1	-	-	1	3	1	6
3	3	2	2	1	3	-	-	-	1	1	-	1	3	3	6

List of Experiment:

Sr. No	Experiment	S/O	Hours
1	Installation of DBMS like MySQL database.	S	2
2	Draw an E-R Diagram using data modelling tools like Oracle SQL developer, Tode for any organization like Insurance Company, Library systems, College Management systems, Hospital Management systems etc.	S	2
3	Convert the E-R Diagram in Relational Tables.	S	2
4	Execute DDL commands to create, alter, rename, truncate and drop tables in SQL.	O	2
5	Use DML Queries to insert, delete, update & display records of the tables.	O	2
6	Implement DCL Statements (GRANT and REVOKE) in SQL	O	2
7	SQL character functions, String functions- Display the results using String	O	2

	operations.		
8	Display the records using Aggregate functions and Group by, having, between, Order by clauses.	O	2
9	Use of Join operations and set operations.	O	2
10	Create Views for the table	O	2
11	Write a program of Database connectivity with any object-oriented language.	O	2
12	Mini Project – Select any one statement from below list.	O	2

Mini Project Statements:

1. Design and develop a Library Management System where users can borrow, return, and manage books. The system should store book details, user information, issued books, and fine calculations.
2. Develop a Hospital Management System to manage patients, doctors, appointments, and medical records. The system should allow patients to book appointments and store medical history.
3. Build a College Management System that keeps track of students, courses, faculty, and exam results. Build an Online Food Ordering System that allows customers to place orders, make payments, and track order status.

S: Study   O: Operational

Textbooks:

1. A. Silberschatz, H.F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill Education.
2. Ramez Elmasri and Shamkant Navathe, "Fundamentals of Database Systems", Pearson Education, Fifth Edition

Reference Books:

1. Raghu Ramkrishnan, Johannes Gehrke, "Database Management System", Fourth Edition, McGraw Hill Education.

Useful Links:

1. https://www.youtube.com/watch?v=c5HAwKX-suM
2. https://onlinecourses.nptel.ac.in/noc22_cs91/preview

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPCCP309
Course Name: Machine Learning Laboratory

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 02 Hrs/Week	01	INT: 25 Marks OE/POE: --

Course Description:

This course provides practical implementation of Supervised and Unsupervised Learning techniques. It also covers core Machine Learning algorithms like classification, regression, clustering.

Course Objectives:
- ❖ To implement basic machine learning algorithms.
- ❖ To implement supervised and unsupervised learning techniques.
- ❖ To implement different clustering techniques.

Course Outcomes:

On completion of the course, student will be able to:

1. Apply and analyze data using different supervised machine learning algorithms.
2. Apply and analyze data using different unsupervised machine learning algorithms.
3. Implement and analyze the data using different clustering techniques.

Prerequisites: Python Programming Language

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	3	-	-	1	-	-	-	2	3	3	4
2	2	2	2	2	3	-	-	1	-	-	-	2	3	3	4
3	2	2	2	2	3	-	-	1	-	-	-	2	3	3	4

List of Experiment:

Sr. No	Experiment	S / O	Hours
1	Implementation of Linear Regression	O	2
2	Implementation of Multivariate Linear Regression	O	2
3	Implementation of Logistic Regression for Binary Classification	O	2
4	Implementation of Multiclass Classification	O	2
5	Implementation of KNN Classifier	O	2
6	Implementation of Naïve Bayes Classifier	O	2
7	Implementation of Bayesian Network	O	2
8	Implementation of Decision Tree	O	2
9	Implementation of SVM	O	2
10	Implementation of K-means Clustering	O	2
11	Implementation of Agglomerative Clustering	O	2

12	Classify text into categories like positive / negative sentiments.	O	2
13	Implement a simple HMM using the hmmlearn library.	O	2
14	Implement regularized logistic regression (Ridge or Lasso).	O	2
15	Design and analysis of sentiment analysis model	O	2

S: Study   O: Operational

Textbooks:

1. "Machine learning", Anuradha Srinivasaghavan and Vincy Joseph, Kindle Edition, 2020, WILEY.
2. "Machine Learning - An Algorithmic Perspective", Stephen Marsland.

Reference Books:

1. "Machine Learning", Tom M. Mitchell, International Edition 1997, McGraw Hills Education

Useful Links:

1. http://livebook.manning.com/book/machine-learning-in-action/about-thisbook/
2. http://nptel.ac.in/courses/106106139
3. http://www.coursera.org/learn/machine-learning

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPCCP310
Course Name: Data Analytical Tools-I

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 01 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 02 Hrs/Week	02	INT: 25 Marks OE/POE: 25 Marks

Course Description:

This course introduces students to understand the fundamental skills for analyzing data in Tableau. They will learn to connect to and customize data sources, including live data and in-memory extracts; edit field metadata, and group fields; apply sorting and filtering techniques; and compare subsets of data using sets. They will work with multiple data sources by using relationships, joins, unions, and blends.

Course Objectives:

❖ To understand the basic business intelligence techniques using tableau.
❖ To visualize the data in different forms using tableau.
❖ To extract meaningful insights from the large-scale data from different sources.

Course Outcomes:

On completion of the course, student will be able to:

1. Apply Tableau techniques to manipulate and prepare data for analysis.
2. Efficiently manage and manipulate datasets in spreadsheet, utilizing tables, formulas, and functions to organize and clean data.
3. Perform exploratory data analysis using Tableau and report insights using descriptive statistics and visualizations.
4. Build interactive dashboards and stories to reveal data insights.

Prerequisites: Basic understanding of Excel

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	3	-	-	-	-	-	-	2	3	3	6
2	2	2	2	2	3	-	-	-	-	-	-	2	3	3	6
3	2	2	2	2	3	-	-	-	-	-	-	2	3	3	6
4	2	2	2	2	3	-	-	-	-	-	-	2	3	3	6

Course Contents

Unit 1	Introduction to Tableau	05 Hours

What is TABLEAU? Unique Features compared to Traditional BI Tools, TABLEAU Overview & Architecture, File Types & Extensions, TABLEAU PRODUCTS-DESKTOP, SERVER, PUBLISHER, PUBLIC, READER. Data Connections in Tableau Interface - Data Connections in the Tableau Interface, Connecting to Tableau Data Server, Types of Join, Data Blending, Establishing a Connection and Creating an Extract, Performance Optimization.

Unit 2	Organizing and Simplifying Data	06 Hours

Filters, Quick Filters, Sorting of Data, Creating Combined Fields, Creating Groups and Defining Aliases, Working with Sets and Combined Sets, Drill to Other Levels in a Hierarchy, Grand totals and Subtotals, Tableau Bins-Fixed Sized Bins, Variable Sized Bins, Creating and using Parameters, Exploring Parameter Controls, Using parameters for titles, field selections, logic statements, Top X, Cross Tabs [Pivot Tables], Page Trials, Total and Sub-Total.

Unit 3	Data Visualization in Tableau	04 Hours

Working with Combined Axis, working with Combination Charts, working with Geocoding and Geographic Mapping, Using Scatter Plots, Using Text tables and Highlight tables, Using Heat Maps, Histograms, Pie Charts, Bullet, Pareto Charts, Waterfall Charts, Gantt Charts, Box Plots, Sparkline Charts, Density Charts, KPI Charts. Working with Strings, Date and Arithmetic Calculations, Working with Aggregation Options and Quick Table Calculation, Custom Calculated Fields, Logic and Conditional Calculations, Conditional Filters, Addressing and Partitioning, Discrete Aggregations, Formatting, Options in Formatting Visualizations, Working with Labels and Annotations, Effective Use of Titles and Captions.

Unit 4	Statistics	03 Hours

Add Reference Lines Bands and Distribution, Working Reference Lines Bands and Forecasting, Trend lines and Trend Models, Cohort Analysis, Forecasting, Build Interactive Dashboards, creating a Dashboard and Importing Sheets, Interaction Exploring Dashboard Actions, Use of Running Actions and Dashboard Actions.

Textbooks:

1. "Mastering Tableau 2019.1", Marleen Meier, David Baldwin, Second Edition
2. "Learning Tableau 2019", Joshua Miligan, 3rd Edition.

Reference Books:

1. "Practical Tableau", Ryan Sleeper, O'Reily
2. "Tableau your data", Daniel G. Murray, Wiley.

Useful Links:

1. https://help.tableau.com/current/offline/en-us/tableau_blueprint.pdf
2. https://cedar.princeton.edu/sites/g/files/toruqf1076/files/media/introduction_to_tableau_training_0.pdf

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Introduction to Tableau and Installation	O	2
2	Connecting to Data and preparing data for visualization in Tableau	O	2
3	Data Aggregation and Statistical functions in Tableau	O	2
4	Data Visualizations in Tableau	O	2
5	Creating scatter plot and using advanced filters	O	2
6	Basic Dashboards in Tableau	O	2
7	Analysis of GDP dataset: 1. Visualize the countries data given in the dataset with respect to latitude and longitude along with country name using symbol maps. 2. Create a bar graph to compare GDP of Belgium between 2006 – 2026. 3. Using pie chart, visualize the GDP of India, Nepal, Romania, South Asia, Singapore by the year 2010. 4. Visualize the countries Bhutan & Costa Rica competing in terms of GDP. 5. Create a scatter plot or circle views of GDP of Mexico, Algeria, Fiji,	O	2

		Estonia from 2004 to 2006.		
		6. Build an interactive dashboard		
	8	Analysis of Amazon Prime Dataset:	O	2
		1. Create a Donut chart to show the percentage of movie and tv shows		
		2. Create a area chart to shows by release year and type		
		3. Create a horizontal bar chart to show Top 10 genre		
		4. Create a map to display total shows by country		
		5. Create a text sheet to show the description of any movie/movies.		
		6. Build an interactive Dashboard.		
	9	Analysis of HR Dataset:	O	2
		1. Create KPI to show employee count, attrition count, attrition rate, attrition count, active employees, and average age.		
		2. Create a Lollipop Chart to show the attrition rate based on gender category.		
		3. Create a pie chart to show the attrition percentage based on Department Category- Drag department into colors and change automatic to pie. Entire view, Drag attrition count to angle. Label attrition count, change to percent, add total also, edit label.		
		4. Create a bar chart to display the number of employees by Age group,		
		5. Create a highlight table to show the Job Satisfaction Rating for each job role based on employee count.		
		6. Create a horizontal bar chart to show the attrition count for each Education field, Education field wise attrition – drag education field to rows, sum attrition count to col,		
		7. Create multiple donut chart to show the Attrition Rate by Gender for different Age group		
	10	Mini project	O	2

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D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSMDML302
Course Name: Fundamentals of Business Intelligence

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 02 Hrs/ Week	02	ISE: --
Tutorials: 00 Hrs/Week		MSE: --
Practicals: 00 Hrs/Week		ESE: 50 Marks

Course Description:

This course introduces the fundamentals of Business Intelligence (BI), covering its definition, applications, and ethical considerations. Students will explore decision-making concepts and Decision Support Systems (DSS), learning how BI enhances strategic choices. The curriculum further delves into data warehousing (DW) and data preprocessing, emphasizing ETL processes, OLAP, and dimensional modeling for effective data analysis.

Course Objectives:

❖ To make the students to understand the fundamentals of Business Intelligence.

❖ To make the students to understand concepts of DSS and types of DSS.

❖ To make the students to learn data warehousing techniques and multidimensional databases.

❖ To make the students to learn the preprocessing, transformation of the data and dimensional modelling.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand the fundamentals of Business Intelligence.
2. Understand the concepts of Decision Support Systems and its types.
3. Interpret data warehousing techniques and multidimensional databases.
4. Elaborate the preprocessing techniques, transformation of the data and dimensional modelling.

Prerequisites: Fundamentals of Data Science

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	-	-	-	-	-	2	-	-	-	-	2	2	2
2	2	2	2	-	-	-	-	-	-	-	-	-	2	2	2
3	2	2	2	-	2	-	-	-	-	-	-	2	2	2	2
4	2	2	2	-	2	-	-	-	-	-	-	2	2	2	2

Course Contents

Unit 1	An Overview of Business Intelligence	06 Hours

Definition of Business Intelligence, Putting Business Intelligence into Context , Business Intelligence Scenarios ,Perspectives in Business Intelligence , Business Intelligence Views on Business Processes, Goals of Business Intelligence, Data, information and knowledge, Role of mathematical models, Business intelligence architectures: Cycle of a business intelligence analysis, Ethics and business intelligence.

Unit 2	Decision Making Concepts	06 Hours

Concepts of Decision Making, Techniques of Decision Support System (DSS), Types of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS.

Unit 3	Data Warehousing (DW)	06 Hours

Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery. ETL process. OLAP introduction.

Unit 4	Data Pre-processing	06 Hours

Discovery, Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization and concept hierarchy generation, Model Planning, Model building, Communicating Results & Findings, Operationalizing. Dimensional Modeling: Facts, dimensions, measures, examples.

Textbooks:

1. "Business Intelligence and Analytics", Drew Bentley, Library Press.
2. "Business Intelligence", Sartaj Singh, Lovely Professional University

Reference Books:

1. "Data Science & Big Data Analytics", David Dietrich, Barry Hiller, EMC education services, Wiley publications, 2012.
2. "Data mining concepts and techniques", Jawai Han, Michelline Kamber, Jiran Pie, Morgan Kaufmann Publishers 3rd edition
3. "Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT", David Loshin, Morgan Kaufmann Publishers, 2009"

Useful Links:

1. https://youtu.be/5nGqJPkRC8o?si=maaIfVbCM3e_cdMu
2. https://youtu.be/tfNGTcoIuJQ?si=z0UQl55lxiOignmj

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL304
Course Name: Cyber Security & Forensics

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week	04	ISE: 20 Marks
Tutorials: 01 Hrs/Week		MSE: 30 Marks
Practicals: 00 Hrs/Week		ESE: 50 Marks
		INT: 25 Marks

Course Description:

This course provides a thorough understanding of cyber forensics, equipping students with the essential knowledge and skills required to investigate digital crimes and analyze digital evidence. The course covers a wide range of concepts, including the use of cyber forensics in law enforcement, cyber forensics services, benefits of professional forensics methodology, and the steps taken by cyber forensics specialists.

Course Objectives:

❖ To learn fundamentals of computer forensics.
❖ To understand social media and E-commerce security.
❖ To analyze and validate forensics data.
❖ To understand cyber laws.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the basics of computer forensics.
2. Understand the legal requirements and regulations related to evidence collection.
3. Describe the process of digital forensic analysis and validations.
4. Develop the skills in analyzing E-Mail and Social Media Investigations.
5. Understand the Mobile Device and Cloud Forensics.
6. Describe the cyber laws.

Prerequisites: Information Security

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2
2	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2
3	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2
4	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2
5	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2
6	2	2	2	-	-	-	-	3	-	-	-	2	1	-	2

Course Contents		
Unit 1	Introduction to Cyber Security	06 Hours

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for

data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

Unit 2	Social Media Overview and Security	06 Hours

Introduction to Social networks, Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

Unit 3	E-Commerce and Digital Payments	06 Hours

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007.

Unit 4	Computer Forensics Fundamentals	06 Hours

Introduction to Computer forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Services, Benefits of professional Forensics Methodology, Steps taken by Computer Forensics Specialists, Types of Computer Forensics Technology, Computer Forensics Evidence and capture.

Unit 5	Evidence Collection	06 Hours

Why Collect Evidence? Types of Evidence, Methods of Collections, Collection Steps, Duplication and Preservation of Digital Evidence, Computer image Verification and Authentication.

Unit 6	Laws and Acts	06 Hours

Computer Crime and Cyber Crime, Types of Cyber Crimes, Indian Laws on Cyber Crimes, Privacy of Online Data, Electronic records.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	Evolution of Cyber Security and Challenges in Modern Cyberspace	S	1
2	Regulation and Governance of Cyberspace	S	1
3	Social Media Privacy and Data Protection Challenges	S	1
4	Misinformation and Cyber Threats in Social Media	S	1
5	Ensuring Security in E-Commerce Transactions	S	1
6	Digital Payment Systems and Fraud Prevention	S	1
7	Role of Computer Forensics in Law Enforcement	S	1
8	Computer Forensics Methodologies and Technologies	S	1
9	Importance of Digital Evidence in Cybercrime Investigations	S	1
10	Cyber Crime and Legal Framework in India	S	1

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Textbooks:

1. "Cyber Crime Impact in the New Millennium", R. C Mishra, Auther Press. Edition 2010.
2. "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd., First Edition, 2011.
3. "Security in the Digital Age: Social Media Security Threats and Vulnerabilities", Henry A. Oliver,

Create Space Independent Publishing Platform, Pearson, 13th November, 2001.

4. "Cyber Laws: Intellectual Property & E-Commerce Security", Kumar K, Dominant Publishers.

Reference Books:

1. "Real Digital Forensics", Keith j. Jones, Richard Bejitlich, Curtis W. Rose, Addison Wesley Pearson Education.

2. "Forensic Compiling, A Tractitioneris Guide", Tony Sammes and Brain Jenkinson, Springer International edition.

Useful Links:

1. https://onlinecourses.swayam2.ac.in/cec21_ge10/preview

2. https://onlinecourses.swayam2.ac.in/cec24_cs14/preview

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL305
Course Name: Software Architecture

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 01 Hrs/Week Practicals: 00 Hrs/Week	04	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks INT: 25 Marks

Course Description:

Software architecture is the set of structures needed to reason about a software system and the discipline of creating such structures and systems. It functions as the blueprints for the system and the development project, which project management can later use to extrapolate the tasks necessary to be executed by the teams and people involved. Software architecture is about making fundamental structural choices that are costly to change once implemented.

Course Objectives:

- ❖ To introduce the student regarding need of the software architectures.
- ❖ To expose the students with the different software architecture patterns.
- ❖ To aware the students regarding the software architecture requirements and design.
- ❖ To strengthen the ability of the students for documenting, implementing and testing the software archite

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the basic building blocks of software architectures.
2. Understand the need and contexts of the software architectures.
3. Design the software architecture by considering quality attributes.
4. Design the software architecture by selecting appropriate pattern as per requirement.
5. Interpret the importance of software architecture requirement and design strategies.
6. Understand the process of documentation, implementation and testing of Software architecture.

Prerequisites: Software Engineering

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	-	-	-	-	-	-	-	1	1	-	2
2	2	2	2	2	-	-	-	-	-	-	-	1	1	-	2
3	2	2	2	2	-	-	-	-	-	-	-	1	1	-	2
4	2	2	2	2	-	-	-	2	-	-	-	1	1	-	2
5	2	2	2	2	-	-	-	-	-	-	-	1	1	-	2
6	2	2	2	2	-	-	-	-	-	-	1	1	1	-	2

Course Contents

Unit 1	Introduction of Software Architecture	08 Hours

Introduction to Software Architecture, Architectural Structures and View, Architectural Patterns, Good Architecture, System's Quality Attributes, Managing Change, System Qualities, Enhancing Communication among Stakeholders, Carrying Early Design Decisions, Defining Constraints, Influencing the Organizational Structure, Enabling Evolutionary Prototyping, Improving Cost and Schedule Estimates, Reusable Model.

Unit 2	Contexts of Software Architecture	05 Hours

Architecture in a Technical Context, Architecture in a Project Life-Cycle Context, Architecture in a Business Context, Architecture in a Professional Context, Stakeholders, Influence on Architecture, Architectures Influence.

Unit 3	Quality Attributes	08 Hours

Architecture and Requirements, Functionality, Quality Attribute Considerations, Specifying Quality Attribute Requirements, Achieving Quality Attributes through tactics, Quality Design Decisions.

Unit 4	Architectural Patterns	08 Hours

Architectural Patterns, Patterns Catalogue, Relationships between Tactics and Patterns, Contents, Using Tactics Together.

Unit 5	Architecture Requirements and Design	08 Hours

Gathering, ASRs from Requirements Documents, Gathering ASRs by Interviewing Stakeholders, Gathering ASRs by Understanding the Business Goals, Capturing ASRs in a Utility Tree, Tying the Methods Together, Designing an Architecture, Design Strategy, The Attribute-Driven Design Method.

Unit 6	Documenting Software Architectures, Implementation, and Testing	08 Hours

Uses and Audiences for Architecture Documentation, Notations for Architecture Documentation, Views, Choosing the Views, Combining Views, Building the Documentation Package, Documenting Behavior, Architecture Documentation and Quality Attributes, Documenting Architecture in an Agile Development Project, Architecture and Testing.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	Case Study Introduction — E-commerce Platform	S	1
2	Applying Architectural Patterns — Online Food Delivery App	S	1
3	Evaluating Quality Attributes — Video Streaming Platform	S	1
4	Explore how architecture handles updates and system changes. (E-learning App)	S	1
5	Learn how a bank uses architectural views to communicate with each stakeholder.	S	1
6	Define requirements for scalability, usability, and security. (Social Media Platform)	S	1
7	Analyze how an E-commerce platform applies architectural tactics to ensure system reliability, performance, and scalability.	S	1
8	Analyze how an Online Banking System makes design decisions to ensure security, reliability, and user satisfaction.	S	1
9	Document the Key Architecture Requirements — Online Learning Platform	S	1
10	Architecture Evaluation and Testing	S	1

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Textbooks:

1. "Software Architecture in Practice", Len Bass Paul Clements Rick Kazman, Pearson Edu(2013), Third Edition

Reference Books:

1. "The Art of Software Architecture", Stephen T. Albin, Wiley dreamtech, (2003).
2. "Pattern Oriented Software Architecture Vol. I", Buschmann, F. WSE.
3. "Large Scale Software Architecture: A Practical Guide Using UM", Jeff Garland, Richard Anthony, Wiley dreamtech
4. "Software Architecture - Perspectives on an Emerging Discipline", Mary Shaw & David Garlan, PHI
5. "Design Patterns: Elements of Reusable Object Oriented Software", Gamma, E. et. Al., Addison Wesley
6. "Software Engineering 7th ed.", Ian Sommerville, Addison Wesley

Useful Links:

1. https://www.digimat.in/nptel/courses/video/106105166/L.33.html

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL306
Course Name: Internet of Things

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 01 Hrs/Week Practicals: 00 Hrs/Week	04	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks INT: 25 Marks

Course Description:

This course covers the basics of IoT, including networking, sensing, data processing, and cloud computing. Students will explore real-world applications in agriculture, healthcare, and vehicles. Advanced topics like AI, big data, 5G, and modern networking technologies will also be introduced. By the end, students will gain a strong foundation in IoT systems and their practical uses.

Course Objectives:

❖ To understand about the fundamentals of Internet of Things.
❖ To explore the latest application areas of IoT.
❖ To understand the latest trends in associated IoT technologies and IoT analytics.

Course Outcomes:

On completion of the course, student will be able to:

1. Describe different IoT technologies & networking components.
2. Classify various sensing devices and actuator types.
3. Demonstrate data formats, IoT processing, and device design considerations.
4. Explain cloud computing, sensor-cloud, and agricultural IoT applications.
5. Illustrate architecture of IOT in different applications.
6. Explore big data, advanced computing, 5G, AI/ML, and modern networking in IoT.

Prerequisites: Fundamentals of Computer Networks.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2
2	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2
3	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2
4	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2
5	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2
6	2	2	-	-	-	-	-	-	-	-	-	1	1	-	2

Course Contents

Unit 1	Fundamentals of Networking for IoT	08 Hours

Introduction to Wireless Sensor Networks,

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components.

Unit 2	IoT Sensing and Actuation	05 Hours

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

Unit 3	IoT Processing Topologies and Architectures	06 Hours

Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

Unit 4	Associated IoT Technologies	06 Hours

Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service. Fog Computing: Introduction.

Unit 5	IoT Case Studies and Challenges	06 Hours

Agricultural IoT – Introduction, Vehicular IoT – Introduction Healthcare IoT – Introduction, Challenges Associated with IoT

Unit 6	Emerging Pillars of IoT	06 Hours

Bigdata, Cloud/fog/edge computing, 5G and beyond, Artificial intelligence (AI)/Machine learning (ML), Cognitive communication networks, Network function virtualization (NFV), Software-defined networks (SDN), Phantom networks.

List of Assignments:

Sr. No.	Name of Assignment	S/O	Hours
1	Introduction to Networking and IoT	S	1
2	IoT Networking Components	S	1
3	Understanding IoT Sensors and Actuators	S	1
4	Sensing Considerations and Sensor Deviations	S	1
5	IoT Data Processing and Topologies	S	1
6	IoT Device Design and Selection	S	1
7	Cloud Computing for IoT	S	1
8	IoT in Agriculture: Case Studies	S	1
9	Vehicular and Healthcare IoT	S	1
10	IoT Data Analytics and Future Trends	S	1
11	Emerging Technologies in IoT	S	1
12	Advanced IoT Architectures: Edge, Fog, and Phantom Networks	S	1

S: Study   O: Operational

Textbooks:

1. "Introduction to IoT", Sudip Misra, Anandarup Mukherjee, Arijit Roy, Cambridge University Press 2021.

Reference Books:

1. "Internet of Things (A Hands-on-Approach)",Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014.
2. "Introduction to Industrial Internet of Things and Industry 4.0.", S. Misra, C. Roy, and A. Mukherjee, 2020, CRC Press.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL307
Course Name: Blockchain Technology

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 00 Hrs/Week	03	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks

Course Description:

This course gives deep understanding about the primitive design principles of Blockchain systems. It gives brief introduction of various secured payment verification protocols which are used in practice. This course also covers design, building and deployment of distributed applications over Blockchain network.

Course Objectives:

❖ To make students to understand how Blockchain systems (mainly Bitcoin and Ethereal) work.
❖ To make students to securely interact with bitcoin and Ethereum.
❖ To make students to design, build, and deploy smart contracts.
❖ To make students to develop distributed blockchain applications (DApp).

Course Outcomes:

On completion of the course, student will be able to:

1. Describe the basic building blocks of Blockchain Technology.
2. Explain the contribution of cryptography, Game Theory and Computer Science in development of Bloc Technology.
3. Describe the basics of Bitcoin as a flavor of Blockchain Technology.
4. Describe working of Ethereum Blockchain.
5. Apply fundamentals of blockchain technology to develop Ethereum Blockchain.
6. Describe the setup of private Ethereum network and create smart contracts with DApp.

Prerequisites: Information Security, Data Structures, Computer Network

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	-	-	-	-	-	1	-	-	-	2	1	-	2
2	2	2	2	2	-	-	-	1	-	-	-	2	1	-	2
3	2	2	2	-	2	-	-	1	-	-	-	2	1	-	2
4	2	2	2	-	2	-	-	1	-	-	-	2	1	-	2
5	2	2	2	2	2	-	-	1	-	-	-	2	1	-	3
6	2	2	2	-	2	-	-	1	-	-	-	2	1	-	2

Course Contents

Unit 1	Introduction to Blockchain	04 Hours

Backstory of Blockchain, Basics of Blockchain, Centralized vs Decentralized systems, Layers of Blockchain, Importance of Blockchain, Blockchain uses and use cases.

Unit 2	Working of Blockchain	08 Hours

Symmetric key cryptography, Cryptographic hash functions, Introduction to Asymmetric key cryptography, Symmetric vs Asymmetric key cryptography, Game theory, Basic building blocks of Blockchain, Markle trees, Properties of Blockchain solutions, Blockchain transactions, Distributed consensus mechanism, Blockchain applications, Scaling Blockchain.

Unit 3	Working of Bitcoin	06 Hours

History of Money, Dawn of Bitcoin, Bitcoin Blockchain, Bitcoin Network, Bitcoin Scripts, Full nodes vs SPVs, Bitcoin wallets.

Unit 4	Working of Ethereum	06 Hours

Journey from Bitcoin to Ethereum, Design philosophy of Ethereum, Ethereum Blockchain, Ethereum smart contracts, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystems.

Unit 5	Blockchain Application Development	06 Hours

Decentralized Applications, Blockchain Application Development, Interacting with the Bitcoin Blockchain, Interacting programmatically with Ethereum- Sending transactions, Interacting programmatically with Ethereum - Creating smart contracts, Interacting programmatically with Ethereum- Executing smart contract functions.

Unit 6	Building an DApp	06 Hours

The DApp, setting up a private Ethereum Network, Creating the smart contract, Deploying the smart contract.

Textbooks:

1. "Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions", Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media.

Reference Books:

1. "Mastering BlockChain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Imran Bashir, Packt Publishing, first edition – 2012.
2. "Blockchain Technology: Cryptocurrency and Applications", S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press, 2019.
3. "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Josh Thompson, Create Space Independent Publishing Platform, 2016.

Useful Links:

1. https://nptel.ac.in/courses/106105235
2. https://nptel.ac.in/courses/106105184
3. https://www.researchgate.net/publication/345045424

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL308
Course Name: Cloud Computing

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week Tutorials: 00 Hrs/Week Practicals: 00 Hrs/Week	03	ISE: 20 Marks MSE: 30 Marks ESE: 50 Marks

Course Description:

This course intends to develop understanding fundamentals of Cloud Computing, its architecture taking inferences from current trends in the industry. This course address recent technologies like DevOps. The syllabus is designed to address necessary skill to begin career in cloud computing. The theme of the subject envisages virtualization, services on demand and much more.

Course Objectives:

- ❖ To understand the basics and history of Cloud Computing.
- ❖ To understand the Cloud Architecture.
- ❖ To know the concepts in Cloud Security.
- ❖ To study and database offering in cloud.
- ❖ To understand the Cloud Development and DevOps.
- ❖ To study cloud management and Optimization tools.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the Cloud Basics, Models and Services.
2. Explain the cloud Architecture and Infrastructure.
3. Describe the implementation of Cloud Security.
4. Elaborate the Database Services provided by cloud (SQL and NoSQL Databases).
5. Understand the Development Technologies including the DevOps.
6. Understand Cloud Management, Optimization and Monitoring Tools.

Prerequisites: Basics of Operating systems, Computer Network

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	-	-	-	-	-	-	-	1	1	-	2
2	2	2	2	-	-	-	-	-	-	-	-	1	1	-	2
3	2	2	2	-	-	-	-	-	-	-	-	1	1	-	2
4	2	2	2	-	-	-	-	-	-	-	-	1	1	-	2
5	2	2	2	-	2	-	-	-	-	-	-	1	1	-	2
6	2	2	2	-	2	-	-	-	-	-	-	1	1	-	2

Course Contents

Unit 1	Introduction to Cloud Computing	06 Hours

Definition, History and Evolution of Cloud, Key Benefit, Service Models (IaaS, PaaS, SaaS), Deployment Modules (Public, Private, Hybrid and Community Cloud), Major Cloud Providers.

Unit 2	Cloud Architecture and Infrastructure	06 Hours

Core components, Virtualization, Microservices and Containerization, Data Center Architecture, Load Balancers, Firewalls, Types of Cloud Storage, Compute Services, Auto Scaling and Load Balancing

Unit 3	Cloud Security	06 Hours

Shared Responsibility Model, Compliance and Regulatory Requirements, IAM Concepts, Multi- Factor Authentication, Encryption, Key Management Services, Data Loss Prevention and Backup Strategies, Securing Web Applications, API Security

Unit 4	Cloud Database Services	06 Hours

SQL vs NoSQL Databases, Use Cases and Comparison, Architecture and Management, Performance Optimization, High Availability, Data Modeling and Querying, Introduction to Big Data, Data Lakes, Data Warehouses, Analytics Services.

Unit 5	Cloud Development and DevOps	06 Hours

DevOps culture and Practices, CI/CD Pipelines: Concepts and Tools, Docker and Kubernetes Basics, Terraform, Setting Up CI/CD Pipelines, Serverless Computing, Use Cases.

Unit 6	Cloud Management and Optimization	06 Hours

Cloud Monitoring and Management Tools, Cloud Automation and Orchestration, Infrastructure as code, Disaster Recovery concepts.

Textbooks:

1. "Cloud Computing for Dummies", Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper, Wiley India Edition, (Unit -1,2,3,4,5.)

2. "Cloud Computing Black Book",Jayaswal, Kallakurchi, Houde, Shah, Jayaswal, Kallakurchi, Houde, Shah, Unit-6.

3. "Cloud Security", Ronald Krutz and Russell Dean Vines, Wiley-India, Unit-3.

Reference Books:

1. "Cloud Computing: Principles and Paradigms", Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley India.

2. "Cloud Computing: A Practical Approach", Anthony T.Velte ,et.al, McGrawHill.

3. "Cloud Security & Privacy", Tim Mather, S. Kumara swammy, S. Latif, SPD, O'REILLY.

4. Google Apps, Scott Granneman, Pearson.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://www.shiksha.com/online-courses/cloud-computing-by-nptel-course-nptel18

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECL309
Course Name: High Performance Computing

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 03 Hrs/ Week	03	ISE: 20 Marks
Tutorials: 00 Hrs/Week		MSE: 30 Marks
Practicals: 00 Hrs/Week		ESE: 50 Marks

Course Description:

This course provides an in-depth exploration of High-Performance Computing (HPC), focusing on the principles, architectures, and programming models used to solve computationally intensive problems. Students will learn about parallel computing, distributed computing, and GPU acceleration.

Course Objectives:

- ❖ To introduce the current trends in computer architecture and programming model.
- ❖ To understand Parallel Hardware and Parallel Software.
- ❖ To learn Distributed Programming with MPI, Shared-Memory Programming with Pthreads and OpenMP.
- ❖ To solve basic parallel problems.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the current trends in computer architecture and programming model.
2. Explain Parallel Hardware and Parallel Software.
3. Illustrate the use of Distributed-Memory Programming with MPI.
4. Describe the use of Shared-Memory Programming with Pthreads.
5. Explain the use of Shared-Memory Programming with OpenMP.
6. Implement a program for parallel architectures.

Prerequisites: Basic understanding of Computer

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	-	-	-	-	-	-	-	-	1	2	2
2	2	2	2	2	3	-	-	-	-	-	-	-	1	2	2
3	2	2	2	2	3	-	-	-	-	-	-	-	1	2	2
4	2	2	2	2	3	-	-	-	-	-	-	-	1	2	2
5	2	2	2	2	3	-	-	-	-	-	-	-	1	2	2
6	2	2	2	2	3	-	-	-	-	-	-	-	1	2	3

Course Contents

Unit 1	Introduction to High Performance Computing	04 Hours

Need of Ever-Increasing Performance, Building Parallel Systems, Need to Write Parallel Programs, Concurrent, Parallel, Distributed, Typographical Conventions, Cluster Computing - architecture, Classifications, Grid Computing - Architecture, Applications.

Unit 2	Parallel Hardware and Parallel Software	06 Hours
Modifications to the von Neumann Model, Parallel Software, Input and Output, Performance, Parallel Program Design, Writing and Running Parallel Programs		
Unit 3	Distributed-Memory Programming with MPI	08 Hours
Compilation and execution, MPI programs, SPMD programs, The Trapezoidal Rule in MPI, Dealing with I/O, Tree-structured communication, MPI Reduce, Collective vs. point-to-point communications, MPI Allreduce, Broadcast, Data distributions, MPI Derived Datatypes, Performance Evaluation of MPI Programs		
Unit 4	Shared-Memory Programming with Pthreads	06 Hours
Processes, Threads, and Pthreads, Hello World, Matrix-Vector Multiplication, Critical Sections, Busy-Waiting, Mutexes, Producer-Consumer Synchronization and Semaphores, Barriers and Condition Variables		
Unit 5	Shared-Memory Programming with OpenMP	05 Hours
Compiling and running OpenMP programs, The program, The Trapezoidal Rule, Scope of Variables, The Reduction Clause, The parallel forDirective, More About Loops in OpenMP: Sorting, Scheduling Loops		
Unit 6	Parallel Program Development	07 Hours
Two n-Body Solvers, Recursive depth-first search, Nonrecursive depth-first search, Data structures for the serial implementations, Performance of the serial implementations, Parallelizing tree search, A static parallelization of tree search using Pthreads, A dynamic parallelization of tree search using Pthreads, Evaluating the pthreads tree-search programs		

Textbooks:

1. "An Introduction to Parallel Programming", Peter S. Pacheco, Elsevier, 2011[Unit 1 to 6]
2. "Introduction to Grid Computing" Bart Jacob, Michael Brown, Kentaro Fukui, NiharTrivedi, International Business Machines Corporation 2005[Grid Computing -Unit 1].
3. "High Performance Cluster Computing: Architectures and Systems", R. Buyya, Pearson Education, 2008[Cluster Computing -Unit 1]

Reference Books:

1. "Parallel computing theory and practice", Michel J. Quinn, TMH
2. "Computer Architecture & Parallel Processing" Kai Hwang & Briggs, McGraw Hill.
3. "Parallel and Distributed Systems", Arun Kulkarni, Napur Prasad Giri, Wiley Publications, Second Edition

Useful Links:

1. https://archive.nptel.ac.in/courses/112/105/112105293/
2. https://archive.nptel.ac.in/courses/106/108/106108055/

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECP310
Course Name: Blockchain Technology Laboratory

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week	01	INT: 25 Marks
Tutorials: 00 Hrs/Week		OE/POE: --
Practicals: 02 Hrs/Week		

Course Description:

This course gives deep understanding about the primitive design principles of Blockchain systems. It gives brief introduction of various secured payment verification protocols which are used in practice. This course also covers design, building and deployment of distributed applications over blockchain network.

Course Objectives:

❖ To make students to understand how Blockchain systems (mainly Bitcoin and Ethereal) work.
❖ To make students to securely interact with bitcoin and Ethereum.
❖ To make students to design, build, and deploy smart contracts.
❖ To make students to develop distributed blockchain applications (DApp).

Course Outcomes:

On completion of the course, student will be able to:

1. Implement the basic operations of blockchain using Python.
2. Implement Go Ethereum using Mist browser.
3. Implement smart transactions using Solidity.
4. Install & implement Hyperledger fabric.

Prerequisites: Information Security, Data Structures, Programming Language.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	3	-	-	2	2	-	-	2	1	2	6
2	2	2	2	2	3	-	-	2	2	-	-	2	1	2	6
3	2	2	2	2	3	-	-	2	2	-	-	2	1	2	6
4	2	2	2	2	3	-	-	2	2	-	-	2	1	2	6

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Write the following programs for Blockchain in Python: A. A simple client class that generates the private and public keys by using the built-in Python RSA algorithm and test it. B. A transaction class to send and receive money and test it. C. Create multiple transactions and display them. D. Create a blockchain, a genesis block and execute it.	O	2

		E. Create a mining function and test it.		
	2	Install and configure Go Ethereum and the Mist browser. Develop and test a sample application.	O	2
	3	Implement and demonstrate the use of the following in Solidity: A. Variable, Operators, Loops, Decision Making, Strings, Arrays, Enums, Structs, Mappings, Conversions, Ether Units, Special Variables. B. Functions, Function Modifiers, View functions, Pure Functions, Fallback Function, Function Overloading, Mathematical functions, Cryptographic functions.	O	2
	4	Implement and demonstrate the use of the following in Solidity: A. Withdrawal Pattern, Restricted Access. B. Contracts, Inheritance, Constructors, Abstract Contracts, Interfaces. C. Libraries, Assembly, Events, Error handling.	O	2
	5	Install hyperledger fabric and composer. Deploy and execute the application.	O	2
	6	Write a program to demonstrate mining of Ether.	O	2
	7	Demonstrate the running of the blockchain node.	O	2
	8	Demonstrate the use of Bitcoin Core API.	O	2
	9	Create your own blockchain and demonstrate its use.	O	2
	10	Build DApps with angular.	O	2

S: Study   O: Operational

Textbooks:

1. "Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions", Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media.

Reference Books:

1. "Mastering BlockChain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Imran Bashir, Packt Publishing, first edition – 2012.
2. "Blockchain Technology: Cryptocurrency and Applications", S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press, 2019.
3. "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Josh Thompson, Create Space Independent Publishing Platform, 2016

Useful Links:

1. https://nptel.ac.in/courses/106105235
2. https://nptel.ac.in/courses/106105184
3. https://www.researchgate.net/publication/345045424

D. Y. Patil College of Engineering & Technology, Kolhapur

(An Autonomous Institute)

Third Year B. Tech CSE (Data Science)

Semester – VI

Course Code: 231DSPECP311

Course Name: Cloud Computing Laboratory

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week	01	INT: 25 Marks
Tutorials: 00 Hrs/Week		OE/POE: --
Practicals: 02 Hrs/Week		

Course Description:

This course intends to provide practical approach towards basic building blocks of Cloud Computing. This course address recent technologies like DevOps. It provides conceptual and practical understanding of virtualization, services on demand and much more.

Course Objectives:

❖ To learn and work with virtualization.

❖ To learn the design and development process involved in creating a cloud based application.

❖ To learn about AWS.

Course Outcomes:

On completion of the course, student will be able to:

1. Configure various virtualization tools such as Virtual Box, VMware workstation.
2. Install and use a generic cloud environment that can be used as a private cloud.
3. Install and use Hadoop.
4. Demonstrate working of DevOps.

Prerequisites: Information Security, Data Structures, Programming Language.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	3	-	-	-	-	-	-	2	2	1	3
2	2	2	2	-	3	-	-	-	-	-	-	2	2	1	3
3	2	2	2	-	3	-	-	-	-	-	-	2	2	1	3
4	2	2	2		3							2	2	1	3

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Implementing Virtualization with Oracle Virtual Box	O	2
2	Create a free-tier Aws Account.	O	2
3	Launching EC2 Instance in AWS	O	2
4	Implementing Identity and Access Management and learn security in AWS cloud	O	2
5	Demonstrate the Use of S3 (Simple Storage Service)	O	2
6	Virtual Private Cloud	O	2

7	Implementing Security Groups	O	2
8	Implementing Networking Firewall in AWS	O	2
9	Implementation of Relational Database Service in AWS	O	2
10	Configure the AWS CloudWatch service to monitor the EC2 instance health parameters and also create alerts.	O	2
11	Install Google App Engine. Create hello world app and other simple web applications using python/java	O	2
12	Install Hadoop single node cluster and run simple applications like wordcount.	O	2
13	Demonstration of DevOps.	O	2

S: Study   O: Operational

Textbooks:

1. "Cloud Computing for Dummies", Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper, Wiley India Edition.
2. "Cloud Computing Black Book", Jayaswal, Kallakurchi, Houde, Shah, Jayaswal, Kallakurchi, Houde, Shah.
3. "Cloud Security", Ronald Krutz and Russell Dean Vines, Wiley-India.

Reference Books:

1. "Cloud Computing: Principles and Paradigms", Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley India.
2. "Cloud Computing: A Practical Approach", Anthony T.Velte ,et.al, McGrawHill.
3. "Cloud Security & Privacy", Tim Mather, S. Kumara swammy, S. Latif, SPD, O'REILLY.
4. Google Apps, Scott Granneman, Pearson.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://www.shiksha.com/online-courses/cloud-computing-by-nptel-course-nptel18

<table>
<tr><td></td><td>D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSPECP312
Course Name: High Performance Computing Laboratory</td></tr>
</table>

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 00 Hrs/ Week	01	INT: 25 Marks
Tutorials: 00 Hrs/Week		OE/POE: --
Practicals: 02 Hrs/Week		

Course Description:

This course provides an in-depth practical exploration of High-Performance Computing (HPC), focusing on the principles, architectures, and programming models used to solve computationally intensive problems. Students will learn about parallel computing, distributed computing, and GPU acceleration.

Course Objectives:

- ❖ To introduce the current trends in computer architecture and programming model.
- ❖ To understand Parallel Hardware and Parallel Software.
- ❖ To learn Distributed Programming with MPI, Shared-Memory Programming with Pthreads and OpenMP.
- ❖ To solve basic parallel problems.

Course Outcomes:

On completion of the course, student will be able to:

1. Implement the concept of Distributed-Memory Programming with MPI.
2. Implement the concept of Shared-Memory Programming with Pthreads.
3. Implement the concept of Shared-Memory Programming with OpenMP.

Prerequisites: Microprocessor and Computer Organization

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	-	3	-	-	-	-	-	-	1	2	2	6
2	2	2	2	2	3	-	-	-	-	-	-	1	2	2	6
3	2	2	2	2	3	-	-	-	-	-	-	1	2	2	6

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Write a short note on significance of parallel programming to enrich the computational performance.	O	2
2	Enumerate the fundamental prerequisites of parallel programming.	O	2
3	Explain the modified architecture of von Neumann model.	O	2
4	Implement and execute a sample parallel program.	O	2
5	Explain the Trapezoidal rule in MPI	O	2
6	How the evaluation for performance of MPI is done?	O	2

7	Implementation of Pthread API	O	2
8	Implement the following concepts using MPI a) Mutexes b) barriers c) busy waiting	O	2
9	Implement the following terms with respect to OpenMP a. The trapezoidal rule b. Scope of the variable	O	2
10	Implement various loops in OpenMP with example.	O	2
11	Implement the concept of two n-body solvers.	O	2
12	Write dawn Difference between Recursive depth - first search and Non Recursive depth - first search	O	2

S: Study   O: Operational

Textbooks:

1. "An Introduction to Parallel Programming", Peter S. Pacheco, Elsevier, 2011
2. "Introduction to Grid Computing" Bart Jacob, Michael Brown, Kentaro Fukui, NiharTrivedi, International Business Machines Corporation 2005
2. "High Performance Cluster Computing: Architectures and Systems", R. Buyya, Pearson Education, 2008

Reference Books:

1. "Parallel computing theory and practice", Michel J. Quinn, TMH
2. "Computer Architecture & Parallel Processing" Kai Hwang & Briggs, McGraw Hill.
3. "Parallel and Distributed Systems", Arun Kulkarni, Napur Prasad Giri, Wiley Publications, Second Edition

Useful Links:

1. https://archive.nptel.ac.in/courses/112/105/112105293/
2. https://archive.nptel.ac.in/courses/106/108/106108055/

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSVSECP301
Course Name: Web Application Development-II

Teaching Scheme:	Credits:	Evaluation Scheme:
Lectures: 01 Hrs/ Week	02	INT: 25 Marks
Tutorials: 00 Hrs/Week		OE/POE: 25 Marks
Practicals: 02 Hrs/Week		

Course Description:

This course introduces students to understand and develop application using the server-side scripting technologies. The course includes basics of PHP, use of functions and arrays, database connectivity and session handling. This aims to equip the students with server-side scripting language to design and develop the applications of different problems.

Course Objectives:

❖ To introduce server-side technologies required for development of web applications.

❖ To expose students to session handling in application development.

❖ To know database connectivity using server side scripting language.

Course Outcomes:

On completion of the course, student will be able to:

1. Apply server-side scripting language for effective web development.
2. Make use of form handling & validation in application for secure data processing.
3. Apply server side technologies to develop web application with database and session handling.

Prerequisites:

Scripting Language, Computer Networks

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO's	PO's												PSO's		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1	2	2	2	2	3	-	-	1	-	-	-	1	2	-	6
2	2	2	2	2	3	-	-	1	-	-	-	1	2	-	6
3	2	2	2	2	3	-	-	1	-	-	-	1	2	-	6

Course Contents

Unit 1	Introduction to PHP	05 Hours

History, General Language Feature, Embedding PHP code in Your Web Pages, Commenting Your Code, Outputting Data to the Browser, PHP supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures

Unit 2	PHP Functions & Arrays	04 Hours

Functions: Invoking a Function, Creating a Function, Function Libraries

Array: Introduction, Creating an array, outputting an Array, Adding and Removing Array Elements, Locating Array Elements, Traversing Arrays, Merging, Slicing, Splicing and Dissecting Arrays

Unit 3	PHP with MySQL	04 Hours

Installation Prerequisites, Using the MySqli Extension, Interacting with the Database, Executing Database Transactions

Unit 4	PHP Session & Handling File Uploads	03 Hours

Session Handlers: What Is Session Handling, Configuration Directives, Working with Sessions, Practical Session-Handling Examples, Creating Custom Session Handlers
Handling File Uploads: Uploading Files with PHP

Textbooks:

1. "Beginning PHP and MySQL: From Novice to Professional", W. Jason Gilmore, Apress Publication Fourth Edition [Unit 1 – 4]

Reference Books:

1. "Modern PHP" Josh Lockhart, O'reilly Publication

Useful Links:

1. https://www.w3schools.com/php/

2. https://www.geeksforgeeks.org/php-tutorial/

Experiment List:

Expt. No.	Experiment	S/O	Hours
1	Installation & configuration of XAMPP web server, PHP and MySQL.	S	2
2	Implementation of variables and expressions using PHP.	O	2
3	Implementation of control structures using PHP.	O	2
4	Implementation of functions using PHP.	O	2
5	Implementation of array using PHP	O	2
6	Design HTML form with PHP validations using GET and POST	O	2
7	Design HTML form with PHP validation using regular expression.	O	2
8	Write a program to insert and display database contents in and from MySQL database using PHP.	O	2
9	Create a CRUD operation using PHP and MySQL.	O	2
10	Write a program to manage session using PHP.	O	2
11	Write a program to develop file up-loader form to upload a file using PHP.	O	2
12	Write a program to create a form to send mail using PHP.		
13	Mini Project – Create an application using client side & server side technologies.	O	2

S: Study   O: Operational

D. Y. Patil College of Engineering & Technology, Kolhapur
(An Autonomous Institute)
Third Year B. Tech CSE (Data Science)
Semester – VI
Course Code: 231DSCCA302
Course Name: Liberal Learning

Teaching Scheme:	Audit Course	Evaluation Scheme:
Lectures: 00 Hrs/ Week		Grade Based Evaluation
Tutorials: 00 Hrs/Week		
Practicals: 02 Hrs/Week		

Course Description & Objectives:

The basic objective of this grading based audit course is to enhance the diversified & multidisciplinary learning attitude among the students. It is implemented through different institute & department level technical as well as non-technical clubs. At the starting of semester - III students will submit the preferences for different clubs available at institute as well as department. It is made mandatory for each student to enroll for minimum two clubs at each semester. The faculty incharge associated with particular club will evaluate the performance of students enrolled for that particular club. Based on the evaluation the grades will be given to each student. Each faculty incharge will prepare the schedule of activities conducted during that semester. It will be the responsibility of the concerned faculty incharge to plan, execute scheduled activities and evaluate the performance of each individual student enrolled for that particular club.

Course Outcomes:

On completion of the course, students will be able to –

1. Understand the various disciplines beyond their major which foster a well-rounded education.
2. Think critically and analytically to solve real world problems in day-to-day life.
3. Understand diverse cultures, perspectives, and traditions enriching the global awareness.
4. Adapt innovative ideas and information to prepare for lifelong learning beyond their formal education.
5. Communicate effectively with clear understanding of innovative ideas.
6. Cultivate personal and intellectual growth in the interdisciplinary thinking and problem-solving skills.

List of Clubs Available at Department:

1. Data Analytics Club:

Aim:

The primary aim of a Data Analytics Club is to create a collaborative and dynamic environment where students can enhance their knowledge, skills, and practical experience in data analytics. This involves fostering a community that promotes learning, innovation, and professional growth in the field of data analytics. The club seeks to bridge the gap between academic knowledge and real-world application, preparing members for successful careers in data analytics by providing resources, networking opportunities, and hands-on experiences.

Objectives:

- Skill Development:
  - Technical Skills: Provide training and workshops on data analytics tools and technologies such as Python, R, SQL, Tableau, Power BI, and machine learning.

- Soft Skills: Enhance communication, teamwork, problem-solving, and project management skills through collaborative projects and presentations.
- **Knowledge Expansion:**
  - Guest Lectures: Invite industry professionals to speak about current trends, best practices, and real-world applications of data analytics.
  - Industry Trends: Keep members informed about the latest developments in data analytics, including new tools, techniques, and methodologies.
- **Hands-on Experience:**
  - Projects: Offer opportunities to work on real-world data projects, either individually or in teams, to apply theoretical knowledge in practical scenarios.
  - Competitions: Organize and participate in data analytics competitions and hackathons to foster a competitive and innovative spirit.
- **Networking:**
  - Industry Connections: Facilitate connections with professionals and alumni working in the field of data analytics.
  - Peer Networking: Create a community where students can collaborate, share knowledge, and support each other's learning journeys.
- **Career Preparation:**
  - Internship Opportunities: Provide information about internships and job openings in the field of data analytics.
  - Resume Building: Offer workshops on resume writing, LinkedIn profile optimization, and interview preparation specific to data analytics roles.
- **Research & Innovation:**
  - Research Projects: Encourage and support members in conducting research projects and publishing their findings in academic or industry journals.
  - Innovation: Foster a culture of innovation by encouraging members to explore new ideas and approaches in data analytics.

Outcomes:

- **Enhanced Skill Set:** Members will develop a strong foundation in data analytics tools and techniques, making them more competitive in the job market.
- **Practical Experience:** Participation in real-world projects and competitions will provide practical experience, helping members to apply theoretical knowledge in practical scenarios.
- **Professional Growth:** Networking opportunities with industry professionals and alumni will help members build valuable connections and gain insights into the industry.
- **Career Readiness:** Members will be better prepared for careers in data analytics through exposure to job opportunities, resume workshops, and interview preparation sessions.
- **Research Contributions:** Members will have opportunities to contribute to the field through research projects and publications.
- **Community Building:** The club will create a supportive community where students can share knowledge, collaborate on projects, and help each other grow.
- **Innovation and Creativity:** Members will be encouraged to think creatively and innovate, leading to new ideas and approaches in data analytics.
- **Increased Confidence:** Through presentations, workshops, and networking events, members will gain confidence in their abilities to communicate and apply data analytics concepts.

2. Rational Programmers Club:

Aim:

The primary aim of a Rational Programmers Club within the Data Science Department is to cultivate a community where students can enhance their coding skills, apply their knowledge to solve real-world problems, and prepare for careers in data science and related fields. The club seeks to create an environment that encourages continuous learning, collaboration, and innovation in coding, particularly as it applies to data science.

Objectives:

- **Skill Development:**
  - Programming Efficiency: Provide training in various programming languages commonly used in data science, such as Python, R, SQL, and Java.
  - Data Science Tools: Teach members how to use data science tools and libraries, such as pandas, NumPy, scikit-learn, TensorFlow, and more.
- **Practical Applications:**
  - Projects: Encourage members to participate in or initiate coding projects that solve real-world data science problems.
  - Hackathons: Organize and participate in hackathons and coding competitions to foster a spirit of innovation and problem-solving.
- **Knowledge Sharing:**
  - Workshops & Seminars: Conduct workshops, seminars, and coding boot camps to share knowledge and best practices in coding and data science.
  - Peer Learning: Promote peer-to-peer learning through study groups, code reviews, and collaborative projects.
- **Career Preparation:**
  - Portfolio Building: Help members build a portfolio of coding projects that demonstrate their skills and knowledge in data science.
  - Career Guidance: Provide guidance on career paths in data science, including resume building, interview preparation, and internship/job search strategies.
- **Networking:**
  - Industry Connections: Facilitate connections with data science professionals, alumni, and industry partners.
  - Community Building: Create a supportive community where members can network, collaborate, and share resources.
- **Innovation & Research:**
  - Cutting-edge Topics: Explore and work on cutting-edge topics in data science, such as machine learning, artificial intelligence, big data analytics, and more.
    Research Projects: Encourage members to participate in or initiate research projects and publish their findings.

Outcomes:

- **Enhanced Coding Skills:** Members will develop strong programming skills and a deep understanding of data science tools and techniques.

- **Practical Experience:** Participation in real-world projects and hackathons will provide hands-on experience, enabling members to apply their knowledge practically.
- **Professional Growth:** Networking with industry professionals and peers will help members build valuable connections and gain insights into the data science industry.
- **Career Readiness:** Members will be better prepared for careers in data science through portfolio building, resume workshops, and interview preparation sessions.
- **Community Contributions:** The club will create a collaborative community where members can share knowledge, support each other's learning, and contribute to the field of data science.
- **Innovation & Research Contributions:** Members will have opportunities to work on innovative projects and research, contributing to advancements in data science.
- **Increased Confidence:** Through coding challenges, presentations, and collaborative projects, members will gain confidence in their abilities to code and solve complex data science problems.
- **Lifelong Learning:** The club will instill a mindset of continuous learning and curiosity, encouraging members to stay updated with the latest developments in coding and data science.

Evaluation:

Evaluation of individual student will be carried out based on following criteria -

1. Knowledge & Understanding
2. Critical Thinking
3. Communication Skills
4. Ethical Reasoning
5. Cultural Awareness and Diversity
6. Interdisciplinary Connections
7. Creativity and Innovation
8. Collaboration and Teamwork

Program Coordinator   HOD CSE(Data Science)   Dean Academics   Principal