D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMENT
Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)
B. Tech. Data Science Engineering (SEMESTER- V)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	23DSEU5P01	PCC	Operating Systems	**3**	3	-	-	20	30	50	-	-	100
2	23DSEU5P02	PCC	Computer Network	**2**	1	2	-	-	-	-	25	25	50
3	23DSEU5P03	PCC	Database Engineering	**3**	3	-	-	20	30	50	-	-	100
4	23DSEU5P04	PCC	Database Engineering Laboratory	**1**	-	2	-	-	-	-	25	25	50
5	23DSEU5P05	PCC	Programming Lab - III	**3**	2	2	-	-	-	-	50	50	100
6	23DSEU5M06	MDM-III	Data Mining and Warehousing	**3**	3	-	-	20	30	50	-	-	100
7	23DSEU5M07	MDM-III	Data Mining and Warehousing Laboratory	**1**	-	2	-	-	-	-	25	-	25
8	23DSEU5E08	PEC-I	Information Security	**3**	**3**	**-**	**-**	**20**	**30**	**50**	**-**	**-**	**100**
9	23DSEU5E09		Theory of Computation										
10	23DSEU5E10		Generative AI										
11	23DSEU5E11	PEC-I	Information Security Lab	**1**	-	**2**	-	-	-	-	**25**	-	**25**
12	23DSEU5E12		Theory of Computation Lab										
13	23DSEU5E13		Generative AI Lab										
14	23DSEU5O14	OEC-III	Business Analytics using Python	**2**	2	-	-	-	-	50	-	-	50
15	23DSEU5D15	AC	Liberal Learning	-	2*	-	-	-	-	-	50*	-	
16	23DSEU5D16	AC	Finishing School Training - V	-	2*	-	-	-	-	-	50*	-	
			Total	**22**	**17**	**10**	**-**						**700**

HONORS

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/	
1	23DSEU5Z01	Honors	Data Security Systems	3	3	-	-	20	30	50	-	-	100
2	23DSEU5Z02	Honors	Data Security Systems Lab	1	-	2	-	-	-	-	25	-	25

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

Course Code:	23DSEU5P01
Course Name:	Operating Systems

L	T	P	Credit
3			3

Course Prerequsites:

Fundamentals of Electronics and Computer

Course Description:

This is one of the core course of Data Science Engineering Programme. In this course you will become familiar with the core concepts of OS - how OS work, how a **processes & threads** are created, **inter-process communication & synchronisation**, the various **scheduling** algorithms, **memory management** & memory allocation strategies, etc. This course will be also helpful for exams like GATE.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Describe the basic concepts of operating systems.
CO2	Evaluate the performance of various scheduling & page replacement algorithms.
CO3	Distinguish techniques of inter process communication and synchronization.
CO4	Identify potential deadlock situations and propose appropriate strategies to handle or avoid deadlocks.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:		
Unit 1	**Introduction**	**6 Hours**
Introduction to OS, OS Structure, Types of OS, OS Kernel, OS Services, Users Prespective of OS, System Boot Process, Architecture of UNIX OS		
Unit 2	**Process, Threads & Scheduling**	**8 Hours**
Process: Concept, States and Transitions, Context, Creation (fork), Termination (exit), Signals (signal, kill), Awaiting Process Termination(wait, waitpid), Invoking other programs (exec), Threads (pthreads) Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.		
Unit 3	**Interprocess Communication**	**6 Hours**
Inter-Process Communication - Pipe, Shared Memory, Message Passing		
Unit 4	**Process Synchronization**	**7 Hours**
Inter-Process Synchronization: The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization		
Unit 5	**Deadlocks**	**6 Hours**
Deadlock: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock		
Unit 6	**Memory Management**	**8 Hours**
Memory background, Hierarchy, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.		

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8th edition, Wiley India, 2009.
2. Operating Systems –Concepts and design –Milan Milenkovic (TMGH)

Reference Books:

1. The Design of Unix Operating System - Maurice J. Bach (PHI)
2. Operating Systems: Internals and Design Principles (8th Edition)- by William Stallings (Pearson Education)
3. Modern Operating Systems by Andrew S. Tanenbaum (Pearson Education International)
4. Unix concepts and administration – 3rd Edition – Sumitabha Das (TMGH).

Course Code:	23DSEU5P02
Course Name:	Computer Networks

L	T	P	Credit
1		2	2

Course Prerequsites:

Nil

Course Description:

This course explains how computers communicate in a network using different devices, protocols, and models like OSI and TCP/IP. It covers important topics such as IP addressing, routing, data transfer methods, and internet services like HTTP, DNS, and email.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Explain fundamental networking concepts and the layered architecture of the OSI and TCP/IP models
CO2	Analyze and apply IP addressing schemes, including subnetting and supernetting for IPv4.
CO3	Describe the functionalities and characteristics of key network layer and transport layer protocols.
CO4	Illustrate the role and operation of common application layer protocols and services.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (OE/POE	50%	100% course contents

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Course Contents:		
Unit 1	**Introduction to Network**	**3 Hours**
Data Communication, Networks Devices & Topologies, Network Types, Internet, Layered Tasks, OSI Reference Model and Layers, TCP/IP Protocol Suite		
Unit 2	**Network Layer**	**4 Hours**
Logical Addressing: IPv4 and IPv6 Addresses, Address Space, Special Addresses, Notations. Subnetting and Supernetting (IPv4). Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation. Internet Control Message Protocol (ICMP). Address Resolution Protocol (ARP). Reverse Address Resolution Protocol (RARP). Routing: Routing Algorithms: Shortest Path, Flooding, Distance Vector Routing, Link State Routing.		
Unit 3	**Transport Layer**	**4 Hours**
Process-to-Process Delivery. Transport Layer Protocols: User Datagram Protocol (UDP): Characteristics and Applications. Transmission Control Protocol (TCP): Connection Establishment, Connection Termination, Flow Control, Congestion Control. Ports and Sockets.		
Unit 4	**Application Layer**	**4 Hours**
DHCP. HTTP and WWW. DNS. Email (SMTP, POP3, IMAP). FTP.		

Text Books:
1. Data Communications and Networking – Behrouz A Forouzan (The McGraw Hill) 2. TCP/IP Protocol Suite- Behrouz Forouzan-(The McGraw Hill)

Reference Books:
1. Computer Networks – Andrew S. Tanenbaum- (Prentice Hall) 5th Edition 2. Computer Networking with Internet Protocols and Technology, William Stallings (Prentice Hall)

Lab Assignments	
Experiment 1: Demonstration of networking commands	2 Hours
Experiment 2: Design and simulation of sample network	2 Hours
Experiment 3: Studying IPv4 and IPv6 addressess	2 Hours
Experiment 4: Design and simulate working of Virtual LAN	2 Hours
Experiment 5: Implementing TCP/UDP client for standard service using socket programming	2 Hours
Experiment 6: Implementing TCP/UDP Server using socket programming	2 Hours
Experiment 7: Installation and Configuration of FOSS server 1 (DHCP/DNS)	2 Hours
Experiment 8: Installation and Configuration of FOSS server 2 (Web, EMail, FTP)	2 Hours

Course Code:	23DSEU5P03
Course Name:	Database Engineering

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Set Theory, Operating System, Data Structures, Basic Software Engineering Concept (SDLC)

Course Description:

The Database Engineering course provides a comprehensive understanding of database systems and their role in the design, development, and management of information systems. It introduces students to database theory, architecture, design methodologies, query languages, and data modeling techniques.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand fundamentals of Database Mmanagement Systems
CO2	Analyze the problem & construct good database design
CO3	Apply SQL queries to design & manage the database
CO4	Understand Transactions Model and the Recovery Schemes in Database Management Systems

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:

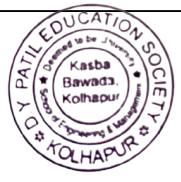
Unit 1	**INTRODUCTION TO DATABASES**	**6 Hours**
Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Specialty Databases, Database Users & Administrators, Structure of Relational Databases, Database Schema, Keys, Relational Query Languages, Relational Operations.		
Unit 2	**E-R MODEL AND DATABASE DESIGN**	**8 Hours**
E-R Model: The Entity-Relationship Model, Constraints, Entity-Relationship Diagrams, Reduction to Relational Schemas **Normalization**: Data Redundancies & Update Anomalies, Functional Dependencies, The Process of Normalization, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form.		
Unit 3	**STRUCTURED QUERY LANGUAGE (SQL)**	**7 Hours**
Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Aggregate Functions, Nested sub Queries, Modification of Databases.		
Unit 4	**DATA STORAGE & INDEXING**	**7 Hours**
File Organization, Organization of records in File, Data Dictionary Storage, Database Buffer, Basic Concepts indexing & hashing, Ordered Indices, B+ Tree Index files, Multiple-Key Access, Static Hashing.		
Unit 5	**TRANSACTION MANAGEMENT**	**7 Hours**
Transaction Concept, A Simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Lock-Based Protocols, Deadlock Handling, Timestamp-Based Protocols, Validation-Based Protocols		
Unit 6	**RECOVERY SYSTEM**	**6 Hours**
Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Failure with Loss of Nonvolatile Storage, Remote Backup Systems		

Text Books:

1. Database System Concepts, A. Silberschatz, H.F. Korth, S. Sudarshan, 6th Edition, Mc Graw Hill Education.
2. Database Systems - A practical approach to Design, Implementation and Management Thomos Connolly, Carolyn Begg, 3rd Edition, Pearson Education

Reference Books:

1. Database Systems – Design, Implementation and Management, Rob & Coronel 5th Edition, Thomson Course Technology
2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 4th Edition,Pearson Education



Course Code:	23DSEU5P04
Course Name:	Database Engineering Lab

L	T	P	Credit
0	0	2	1

Course Prerequsites:

Set Theory, Fundamental of Software Engineering (SDLC)

Course Description:

The Database Engineering course provides a comprehensive understanding of database systems and their role in the design, development, and management of information systems. It introduces students to database theory, architecture, design methodologies, query languages, and data modeling techniques.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand fundamentals of database management systems
CO2	Analyze & construct good database design
CO3	Apply SQL queries to design & manage the database

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal Assessment	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	Practical/Oral Examination

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Course Contents:	
Assessment No. 1 : Draw an E-R Diagram of any organization	
Assessment No. 2 : Reduce above mentioned E-R Diagram into Relational Model	
Assessment No. 3 : Normalize any database from first normal form to Boyce-Codd Normal Form (BCNF)	
Assessment No. 4 :Use DDL Queries to create, alter (add, modify, rename, drop) & drop Tables	
Assessment No. 5 : Use DML Queries to insert, delete, update & display records of the tables	
Assessment No. 6 : Create table with integrity constraints like primary key, check, not null and unique	
Assessment No. 7 : Create table with referential integrity constraints with foreign key, on delete cascade and on delete set null	
Assessment No. 8 : Display the results of set operations like union, intersections & set difference	
Assessment No. 9 : Display the results of Join Operations like cross join, self join, inner join, natural join, left outer join, right outer join and full outer join	
Assessment No. 10 : Display the records using Aggregate functions like min, max, avg, sum & count. Also use group by, having clauses	
Assessment No. 11 : Display the results using String operations	
Assessment No. 12 : Create & Update views for any created table	
Assessment No. 13 : Study of B+ tree indexing	
Assessment No. 14 : Implement static hashing (Simulation)	
Text Book:	
Williams Stallings – Cryptography and Network Security Principles and Practices (Unit 1 to 5) Pearson Education (LPE), 7th Edition	

Course Code:	23DSEU5P05
Course Name:	Programming Lab - III

L	T	P	Credit
2	0	2	3

Course Prerequsites:

1. Procedural Programming Language

Course Description:

This course introduces students to the principles of object-oriented programming using Java. Students will develop practical skills through hands-on coding exercises and projects, learning to design and implement efficient, reusable, and maintainable code using OOP concepts.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand the fundamentals of Object-Oriented Programming (OOP) and Java language constructs.
CO2	Apply various object-oriented features to solve real-life problems using Java Programming language.
CO3	Make use of file I/O operations and exceptions in Java to create robust and error-resilient programs.
CO4	Utilize appropriate collection classes to solve real-world programming problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal Assessment	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	Practical/Oral Examination

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Course Contents:

Unit 1	**Introduction to OOPs concepts and Java Programming**	**3 Hours**
Introduction to procedural & object-oriented programming, Limitations of procedural programming, Need of object-oriented programming, **Fundamentals of object-oriented programming:** objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. **Introduction to Java Programming:** 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, Big Numbers, ArraysJagged Array.		
Unit 2	**Classes and Objects**	**5 Hours**
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(Access specifiers – public, private, protected,), Static Fields and Methods, this keyword, Object Cloning, use of the new keyword, Method overloading, array of objects, passing objects to functions, returning object.		
Unit 4	**Inheritance, Interface and Packaging**	**6 Hours**
Inheritance: Definition, Superclasses, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Nested classes & Inner Classes. **Interfaces:** Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving Interfaces, Default Methods. **Packages:** Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and Class Files		
Unit 5	**Exception Handling and File I/O**	**6 Hours**
I/O Streams: Byte Stream – InputStream, OutputStream, DataInputStream, DataOutputStream, FileInputStream, FileOutputStream, Character Streams, BufferedStream, Scanner, File, RandomAccesFile. **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, Advantages of Exceptions, Tips for Using Exceptions.		
Unit 5	**Multithreading and Collections**	**6 Hours**
Multithreading: Processes and Threads, Runnable Interface and Thread Class , Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization **Collections:** Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework.		

Text Books:

1. "Core Java Volume I – Fundamentals" by Cay S. Horstmann and Gary Cornell
2. "Java: The Complete Reference" by Herbert Schildt

Reference Books:

1. "Head First Java" by Kathy Sierra and Bert Bates

List of Experiments:

1. Write a Java program to implement data types, operators
2. Write a Java program to implement simple class and objects
3. Write a Java program to implement Contructor overloading
4. Write a Java program to implement Method overloading
5. Write a Java program to implement different types of inheritance
6. Write a Java program to implement abstract class
7. Write a Java program to implement interface
8. Write a Java program to implement package
9. Write a Java program to implement File Handling
10. Write a Java program to implement Exception Handling
11. Write a Java program to implement Multithreading
12. Write a Java program to implement different collection

Course Code:	23DSEU5M06	L	T	P	Credit
Course Name:	Data Mining and Warehousing	3	0	0	3

Course Prerequsites:

Foundational knowledge of Database Systems,Data Structures, Statistics and Probability

Course Description:

This course introduces the fundamental concepts and techniques of data mining and data warehousing. It equips students with the skills to design and implement data warehouses and extract meaningful insights from large datasets through data mining. Students will explore various data mining algorithms and learn how to preprocess data effectively. The course also covers data warehouse architecture, OLAP operations, schema modeling, and real-world applications in business and industry. Emphasis is placed on both theoretical understanding and practical implementation using industry-standard tools.

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Implement and evaluate data mining algorithms such as classification, clustering, and association rule mining.
CO2	Understand the concepts and architecture of data warehousing, including schema design and OLAP operations.
CO3	Apply data preprocessing techniques to prepare real-world datasets for analysis.
CO4	Utilize data mining and warehousing tools to analyze large datasets and generate actionable insights for business applications.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation1 [10 Mark	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination [30 M	30%	50% Course Contents
3	In Semester Evaluation2 [10 Mark	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	nd Semester Examination [50 Mark	50%	100% Course Contents

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Course Contents:

Unit 1	**Introduction to Data Mining**	**6 Hours**
Definition, Importance, and Applications of Data Mining, Knowledge Discovery in Databases (KDD) Process, Types of Data: Structured, Semi-structured, and Unstructured, Data Preprocessing: Cleaning, Integration, Reduction, and Transformation, Data Mining Architecture		
Unit 2	**Data Mining Techniques**	**9 Hours**
Association Rule Mining: Apriori Algorithm, FP-Growth algorithms Clustering: K-Means, Hierarchical Clustering, Outlier Detection Classification: Decision Trees, Bayesian Classification, Rule-based classification, Model evaluation and cross-validation		
Unit 3	**Advanced Topics in Data Mining**	**6 Hours**
Mining data streams, Web and text mining, Temporal and spatial data mining, Social network mining		
Unit 4	**Introduction to Data Warehousing**	**6 Hours**
Data Warehousing concepts, Differences between OLTP and OLAP, Data warehouse architecture, Data Marts, ETL Process (Extract, Transform, Load), Metadata		
Unit 5	**Data Warehouse Design and Implementation**	**9 Hours**
Dimensional modeling: Star, Snowflake, Fact Constellation Fact tables and Dimension tables Data Cube and OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot)		
Unit 6	**Data Warehousing and Mining Applications**	**6 Hours**
Real-world applications, Trends in data warehousing (cloud DW, real-time DW), Data privacy and ethical issues in data mining, Case studies from industry		

Text Books:

1.“Data Mining Concepts and Techniques”, Jiawei Han, Micheline Kamber and Jian Pei , Third Edition, Elsevier, 2012.
2. "Data Warehousing: Concepts, Techniques, Products, and Applications",P. P. Chen,Pearson Education,First Edition, 2003 3.Building the Data Warehouse by William H. Inmon, Wiley India, 4th Edition, 2005

Reference Books:

1. The Data Warehouse Toolkit by Ralph Kimball and Margy Ross, Wiley, 3rd Edition, 2013
2. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, and Mark A. Hall, Morgan Kaufmann, 3rd Edition, 2011
3. Data Mining Techniques by Arun K. Pujari, Universities Press, 4th Edition, 2013

Course Code:	23DSEU5M07	L	T	P	Credit
Course Name:	Data Mining and Warehousing Laboratory			2	1

Course Prerequsites:

Basic knowledge of programming, SQL, database concepts, and foundational statistics

Course Description:

This course provides a practical introduction to Data Mining and Data Warehousing, focusing on core concepts like data preprocessing, classification, clustering, and schema design. Through simplified hands-on assignments, students learn to apply techniques such as association rule mining and ETL processes. Real-world case studies help bridge theory and practice, preparing students for analytical roles and projects.

Course Outcomes	After the completion of the course the student will be able to -
CO1	Apply data preprocessing techniques and identify appropriate types of data for mining tasks
CO2	Demonstrate practical skills in using Data mining and Warehousing tools and technologies
CO3	Learn the use of technology in real-world analytical scenarios

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation [25 Mar	100%	Experiment, Practical Performance and Oral Exam etc.

List of Experimen

1	Data Preprocessing on a Sample Dataset
2	Identify Data Types and Create a KDD Process Flow
3	Implement Association algorithms on market basket data.
4	Implement Clustering Techniques on real-world dataset.
5	Build models using Decision Trees and Naive Bayes. Evaluate using cross-validation.
6	Text Mining from Online Reviews
7	Draw a Social Network Graph
8	Design a basic ETL process using a dataset
9	Create a Data Warehouse Schema
10	Case Study Analysis

Text Books:

1.“Data Mining Concepts and Techniques”, Jiawei Han, Micheline Kamber and Jian Pei , Third Edition, Elsevier, 2012.
2. "Data Warehousing: Concepts, Techniques, Products, and Applications",P. P. Chen,Pearson Education,First Edition, 2003
3.Building the Data Warehouse by William H. Inmon, Wiley India, 4th Edition, 2005

Reference Books:

1. The Data Warehouse Toolkit by Ralph Kimball and Margy Ross, Wiley, 3rd Edition, 2013
2. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, and Mark A. Hall, Morgan Kaufmann, 3rd Edition, 2011
3. Data Mining Techniques by Arun K. Pujari, Universities Press, 4th Edition, 2013

Course Code:	23DSEU5E08
Course Name:	Information Security

L	T	P	Credit
3			3

Course Prerequsites:

Computer Network, Data Communication, Engg. Mathematics

Course Description:

This course gives you practical survey of both the principles and practice of cryptography and network security. In the first part of course, the basic issues to be addressed by a network security capability are explored by providing a tutorial and survey of cryptography and network security technology. The later part of course deals with the practice of network security.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Explain the use of Cryptographic algorithms to ensure data protection and integrity.
CO2	Apply the knowledge of cryptographic techniques to solve the problems on security.
CO3	Illustrate the different Network and Internet security protocols in TCP/IP stack.
CO4	Analyze the security facilities designed to provide system security.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE	20%	
2	MSE	30%	
3	ESE	50%	

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Contents:

Unit 1	Introduction to Information Security	5 Hours

Overview:
Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security

Classical Encryption Techniques:
Symmetric Cipher Model,Substitution Techniques, Transposition Techniques, Rotor machines, Steganography.

Case Study 1.1: Perform Encryption and Decryption using crypt tool.

Unit 2	Symmetric and Asymmetric Key Cryptography	8 Hours

Block Ciphers and the Data Encryption Standard:
Block Cipher Structure, Data Encryption Standard (DES), A DES Example, Strength of DES, Block Cipher Design Principles, AES Structure, Multiple Encryption and Triple-DES

Public Key Cryptography:
Principles of Public-Key Cryptosystems, RSA Algorithm, Other Public key Cryptosystems - Diffie-Hellman Key Exchange, ElGamal Cryptographic system

Unit 3	Cryptographic Authentication Functions	8 Hours

Cryptographic Hash Functions:
Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA)

Message Authentication Codes:
Message Authentication Requirements, Message Authentication Functions, Requirements for MAC and Security of MACs, MACs Based on Hash Functions: MAC, MACs Based on Block Ciphers: DAA and CMAC

Digital Signatures:
Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS)

Case Study 3.1: Working of Digital signature software tool Sign server

Unit 4	Key Management and User Authentication	8 Hours

Key management:
Symmetric Key Distribution Using Symmetric Encryption,Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure

User Authentication Protocol:
Remote User-Authentication Principles, Remote User-Authentication UsingSymmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption.

Unit 5	Internet security Protocols	6 Hours

Transport-Level Security:
Web Security Issues, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, SSH

Electronic Mail Security:
Pretty Good Privacy (PGP), S/MIME, SET

IP Security:
IP Security Overview, IP Security Policy, Encapsulating Security Payload

Case Study 5.1: Perform surveillance through packet sniffer tool like Wireshark &TCP Dump.

Unit 6	Firewall and Intrusion detection system	8 Hours

Firewalls:
Introduction, Types of firewall, Firewall configuration, VPN, Types of VPN
IDS:
Overview of IDS, IDS Components, Approaches of IDS
SIEM:
Introduction to SIEM,SIEM Scenario and process flow, SIEM architecture, SIEM features
Case study 6.1: Run Online Scanners like Virus Total, Jotti and No VirusThanks

Reference Books:

Textbooks:
1. Williams Stallings – Cryptography and Network Security Principles and Practices (Unit 1 to 5) Pearson Education (LPE), 7th Edition
2. Network Security, Firewalls, and VPNs, 3rd Edition by J. Michael Stewart, Denise Kinsey (Unit 6)

References:
1. Cryptography & Network Security B.A. Forouzan McGrawHill
2. Cryptography and network security – Atul Kahate (TMGH)
3. Handbook of Applied Cryptography - Menezes, an Oorschot, and S.A. Vanstone

Course Code:	23DSEU5E09	L	T	P	Credit
Course Name:	Theory of Computation	3	1		4

Course Prerequsites:

Discrete Mathematics, Sets, Cartesian Product and Functions

Course Description:

This course deals with the theoretical background of computer science.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Explain the fundamental concepts of formal languages, grammars, and automata.
CO2	Classify formal languages on the basis of their features.
CO3	Relate the computational models with the modern day computer technologies.
CO4	Design computational machines of various types for specified problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Contents:

Unit 1	**Mathematical Induction, Regular Languages & Finite Automata**	**8 Hours**
The Principle of Mathematical Induction Recursive Definitions, Definition & types of grammars & languages, Regular expressions and corresponding regular languages, examples and applications, unions, intersection & complements of regular languages, Finite automata-definition and representation, on-deterministic F.A.,NFA with null transitions, Equivalence of FA's , NFA's and NFA's with null transitions.		
Unit 2	**Kleene's Theorem**	**4 Hours**
Part I & II statements and proofs, minimum state of FA for a regular language, minimizing number of states in Finite Automata.		
Unit 3	**Grammars and Languages**	**10 Hours**
Derivation and ambiguity, BNF & CNF notations, Union, Concatenation and *'s of CFLs, Eliminating production & unit productions from CFG, Eliminating useless variables from a context Free Grammar. Parsing: Top-Down, Recursive Descent and Bottom-Up Parsing.		
Unit 4	**Push Down Automata**	**4 Hours**
Definition, Deterministic PDA & types of acceptance, Equivalence of CFG's & PDA's.		
Unit 5	**CFL's and non CFL's**	**4 Hours**
Pumping Lemma and examples, intersections and complements		
Unit 6	**Turing Machines**	**10 Hours**
Models of computation, definition of Turing Machine as Language acceptors, combining Turing Machines, Computing a function with a TM, Non-deterministic TM and Universal TM, Recursively enumerable languages,Unsolvable problems.		

Text Books:

1.Introduction to languages & Theory of computations – John C. Martin (MGH)
2.Discrete Mathematical Structures with applications to Computer Science—J .P.Trembley &R.Manohar

Reference Books:

1.Introduction to Automata Theory , Languages and computation – John E. Hopcraft , Rajeev Motwani, Jeffrey D. Ullman (Pearson Edition)
2.Introduction to Theory of Computations – Michael Sipser (Thomson Brooks / Cole)
3.Theory Of Computation- Vivek Kulkarni, 1st edition OXFORD university Press
4.Theory Of Computation A problem Solving Approach Kavi Mahesh Wiley India

Course Code:	23DSEU5E10
Course Name:	Generative AI

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Course Description:

Course Outcomes: After the completion of the course the student will be able to -

CO1	Explain fundamental concepts of Generative AI.
CO2	Design and implement effective prompt engineering techniques for various NLP tasks
CO3	Apply tuning and optimization techniques
CO4	Develop creative and productive applications using generative AI tools

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	**Introduction to Genertaive AI**	**4 Hours**
1.what is AI, History, what is Generative AI 2.Types of Generative models 3.AI Prompt Writing? prompts, type of prompts 4.What is text to-text Generative AI 5.General Rules for Prompt Writing 6.Generative languages models 7.ChatGPT 3.5, chatGPT4.0, Examples, Google Bard, Ethics in AI		
Unit 2	**Prompt Engineering - NLP and ML Foundations**	**10 Hours**
1. Techniques for Prompt Engineering 2. Benefits of Prompt Engineering, what is NLP 3.What is ML, and examples 4. Common NLP Tasks-text classification, languge Translation, 5.Named Entity Recognition (NER) 6. Question answering , text Generation, sentiment analysis 7.Text summarization, recommendation system		
Unit 3	**Tuning and optimization Techniques**	**7 Hours**
1.Fine-tuning prompts 2.Prompt Tuning 3.Filtering and post-processing 4.Reinforcement learning 5.Use cases and applications 6.Pre-training 7.Designing effective prompts		
Unit 4	**AI for Creative Applications**	**7 Hours**
1.Presentations gamma.ai 2.TL, draw,AI overpowered tools 3.Image generation: Explorning tools like DALL-E and their creative applications 4.product design ideas 5.Poem generator, video description 6.Music generation		
Unit 5	**AI for Productivity Improvement**	**7 Hours**
1.Rytr for blog idea and outline, business idea pitch 2.Cover Letter,Job Description 3.Reply to reviews,keyword Extractor, tagline and Headlines etc 4.ResumeBuilding com, Blog writing/ Text summarization using copy.ai 5.Image code-Blackbox		
Unit 6	**Generative AI tools and case Studies**	**6 Hours**
1.Hugging face transformers 2.OpenAI GPT3 API 3.Google cloud AI platform, Mid Journey,DALL E-2, Google Bard 4.case Studies-Token(API) key generation on LLM(openAI, Google,Hugging face) in Google colab 5.Hugging face demonstration of various models-image-to-text, 6.language translation, summarization 7.text generation, text-to-image 8.image-to-text,AI-power point and excel 9.Use of AI in word,power point and excel		

Text Books:

1. "Generative AI for everyone" by Altaf Rehman, Bluerose Publishers Pvt. Ltd., First Edition, 2024
2. "Prompt Engineering for Genrative AI" by Jems Phoenix and Mike Taylor, Shroff Publishers and distributors Pvt. Ltd, First Edition, 2025
3. "Generative AI for Begineers Playbook" by Branson Adams, Walking Crow Publishing, First Edition, 2023

Reference Books:

1. "Rise of Generative AI and ChatGPT" by Utpal Chakraboraty, Sumit Kumar and Soumyadeep Roy, BPB

Course Code:	23DSEU5E11
Course Name:	Information Security Tutorial

L	T	P	Credit
		2	1

Course Prerequsites:

Computer Network and Programing Language like Java/Python

Course Description:

This course is to designed to do the practical implementation of Cryptographic algorithms and have the hands-on experience on open source/free tools available to demonstrate the security concepts.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Demonstrate encryption and authentication mechanisms.
CO2	Implement various cryptographic algorithms using various prgramming languages.
CO3	Make use of various security tools to analyze the security concepts.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	100%	

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Contents:	
Assessment No. 1 :Classical Encryption Techniques : Substitution Ciphers	**2 Hours**
To implement the program of substitution ciphers like Caesar Cipher, Playfair Cipher, Hill Cipher	
Assessment No. 2 : Classical Encryption Techniques : Transposition Ciphers	**2 Hours**
To implement the program of Transposition ciphers like Rail fence technique, Columnar transposition	
Assessment No. 3 : Symmetric Ciphers : DES	**2 Hours**
Implement a program to perform Encryption and Decryption using DES cipher	
Assessment No. 4 : Symmetric Ciphers : AES	**2 Hours**
Implement a program to perform Encryption and Decryption using AES cipher	
Assessment No. 5 : Asymmetric Ciphers : RSA Algorithm	**2 Hours**
Implement a program to perform Encryption and Decryption using RSA algorithm	
Assessment No. 6 :Key Exchange Algorithm: Diffie Hellman Algorithm	**2 Hours**
To implement a program using Diffie Hellman key exchange algorithm	
Assessment No. 7 : Message Integrity using Hash function	**2 Hours**
To implement the program on Hash functions –SHA, MD5 etc to show the integrity check on the files transferred	
Assessment No. 8 :Digital Signature algorithm using RSA or DSS Approach	**2 Hours**
Implement the Digital Signature algorithm using RSA approach (SHA256withRSA) or DSS approach(SHA256with DSA)	
Assessment No. 9 : Demonstration of Creation of Digital Signature & Digitally Signed Certificate	**2 Hours**
To implement a program to show encryption and decryption using RSA algorithm in	
Assessment No. 10 : Demonstration of SSL protocol	**2 Hours**
Working of SSL protocol using Network analyzer tools like Wireshark	
Assessment No. 11 : Demonstration of User Authentication Tools	**2 Hours**
Use any of the user authentication tool like Kerberos, NTLM, LDAP, RADIUS	
Assessment No. 12 :Demonstration of Firewall & IDS/ IPS Systems	**2 Hours**
Use any of the Windows and Linux based firewall for demonstration	
Assessment No. 13 : Demonstration and Implementation of Malicious Softwares	**2 Hours**
Assessment No. 14 : Demonstration of VAPT Tools	**2 Hours**
Text Book:	
Williams Stallings – Cryptography and Network Security Principles and Practices (Unit 1 to 5) Pearson Education (LPE), 7th Edition	

Course Code:	23DSEU5E12	L	T	P	Credit
Course Name:	Theory of Computation Tutorial		1		1

Course Prerequsites:

1. Discrete Mathematics, Sets, Cartesian Product and Functions

Course Description:

This course deals with the theoretical background of computer science.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Explain the fundamental concepts of formal languages, grammars, and automata.
CO2	Classify formal languages on the basis of their features.
CO3	Relate the computational models with the modern day computer technologies.
CO4	Design computational machines of various types for specified problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:
Tutorial 1: Mathematical Foundations and Introduction Sets, relations, functions, and basic proof techniques Strings, languages, and alphabet operations Introduction to formal computational models Mathematical induction and proof by contradiction
Tutorial 2: Deterministic Finite Automata (DFA) DFA definition, design, and state diagrams Language acceptance and transition functions DFA construction for pattern recognition Closure properties and decision problems
Tutorial 3: Nondeterministic Finite Automata (NFA and ε-NFA) NFA design and ε-transitions Subset construction (NFA to DFA conversion) ε-NFA to NFA conversion
Tutorial 4: Regular Expressions and Regular Languages Regular expression syntax and semantics Thompson's construction (RE to ε-NFA) State elimination method (DFA to RE)
Tutorial 5: Properties of Regular Languages Pumping lemma for regular languages Proving languages are not regular Myhill-Nerode theorem and DFA minimization Closure properties and decidability problems
Tutorial 6: Context-Free Grammars (CFG) CFG definition and derivation processes Parse trees and ambiguity resolution Grammar design for programming language constructs Chomsky Normal Form and Greibach Normal Form
Tutorial 7: Pushdown Automata (PDA) PDA definition and stack-based computation PDA design for context-free languages Equivalence between CFGs and PDAs
Tutorial 8: Properties of Context-Free Languages Pumping lemma for context-free languages CYK algorithm for membership testing Closure properties of CFLs
Tutorial 9: Turing Machines Turing machine definition and operation TM design for computational problems Multi-tape TMs
Tutorial 10: Decidability and Complexity Theory Decidable vs. undecidable problems Reduction techniques for proving undecidability

Text Books:

1.Introduction to languages & Theory of computations – John C. Martin (MGH)
2.Discrete Mathematical Structures with applications to Computer Science—J .P.Trembley &R.Manohar

Reference Books:

1.Introduction to Automata Theory , Languages and computation – John E. Hopcraft , Rajeev Motwani, Jeffrey D. Ullman (Pearson Edition)
2.Introduction to Theory of Computations – Michael Sipser (Thomson Brooks / Cole)
3.Theory Of Computation- Vivek Kulkarni, 1st edition OXFORD university Press
4.Theory Of Computation A problem Solving Approach Kavi Mahesh Wiley India

Course Code:	23DSEU5E13
Course Name:	Generative AI Lab

L	T	P	Credit
0	0	2	1

Course Prerequsites:

Basic understanding of Python programming, Machine Learning fundamentals

Course Description:

This laboratory course provides hands-on experience with generative artificial intelligence technologies, tools, and applications. Students will work with various generative AI models, implement prompt engineering techniques, and develop creative applications using state-of-the-art AI tools and platforms.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Implement and demonstrate fundamental generative AI models and techniques using practical tools and platforms
CO2	Design, develop and evaluate effective prompt engineering strategies for various NLP tasks
CO3	Apply and optimize generative AI models using fine-tuning, reinforcement learning, and other advanced techniques
CO4	Create innovative applications using generative AI tools

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	100%	Practical performance, Internal POE

D.Y. PATIL EDUCATION SOCIETY Kasba Bawada, Kolhapur KOLHAPUR

Course Contents:		
Experiment 1:	**Study of various Generative AI Tools and Platforms**	**4 Hours**
Experiment 2:	**Implement different types of prompts (zero-shot, few-shot, chain-of-thought)**	**2 Hours**
Experiment 3:	**Implement text classification using prompt engineering**	**2 Hours**
Experiment 4:	**Develop applications for content generation and summarization**	**2 Hours**
Experiment 4:	**Use of AI APIs and implement model customization**	**4 Hours**
Experiment 5:	**Generate images using DALL-E and Midjourney**	**4 Hours**
Experiment 6:	**Build applications for creative content using AI**	**4 Hours**
Experiment 7:	**Create AI-powered productivity tools**	**4 Hours**
Experiment 8:	**AI for Productivity Improvement**	**4 Hours**

Text Books:

1. "Generative AI for everyone" by Altaf Rehman, Bluerose Publishers Pvt. Ltd., First Edition, 2024
2. "Prompt Engineering for Genrative AI" by Jems Phoenix and Mike Taylor, Shroff Publishers and distributors Pvt. Ltd, First Edition, 2025
3. "Generative AI for Begineers Playbook" by Branson Adams, Walking Crow Publishing, First Edition, 2023

Reference Books:

1. "Rise of Generative AI and ChatGPT" by Utpal Chakraboraty, Sumit Kumar and Soumyadeep Roy, BPB Publications,

Course Code:	23DSEU5O14
Course Name:	Business Analysis Using Python

L	T	P	Credit
2			2

Course Prerequsites:

Basic understanding of programming concepts, Python, knowledge of statistics and basic mathematics knowledge of spreadsheets or data handling tools.

Course Description:

This course teaches students how to use Python for analyzing business data, identifying trends, and making informed decisions through real-world examples.

Course Outcomes: After the completion of the course the student will be able to -

CO1	To introduce students to the role of data in business decision-making
CO2	To equip students with Python tools for data extraction, analysis, and visualization.
CO3	To teach students to use statistical and machine learning methods for business insights.
CO4	To develop real-world business intelligence solutions using Python.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination	100%	

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Contents:		
Unit 1	**Introduction to Business Analytics & Python Basics**	**5 Hours**
Role of Business Analytics in organizations **Types of Business Analytics:** Descriptive, Predictive, and Prescriptive **Python Basics:** Data types, functions, loops, list comprehension **Python libraries:** pandas, numpy, matplotlib, seaborn **Working with data:** CSV, Excel, JSON **Data cleaning & preprocessing techniques**		
Unit 2	**Exploratory Data Analysis & Visualization**	**7 Hours**
Understanding business problems through EDA **statistics** correlation, regression and hypothesis testing Advanced visualizations with seaborn and matplotlib Detecting outliers, missing values, and anomalies Case study: Retail sales data or marketing campaign data		
Unit 3	**Predictive Analytics & Machine Learning**	**7 Hours**
Introduction to supervised and unsupervised learning **Regression models**: Linear, Multiple, Logistic **Classification:** Decision Trees, KNN, Naive Bayes **Clustering techniques:** K-Means Model evaluation metrics (Accuracy, Precision, Recall, F1 Score) Business application examples (e.g., customer churn prediction, sales forecasting)		
Unit 4	**Business Intelligence and Reporting with Python**	**6 Hours**
Introduction to BI tools & Python integration, Automating reports with Python, Data storytelling and presentation, Working with dashboards using plotly, dash, or streamlit **Capstone project: Solving a business case using Python**		

Textbooks and Reference Books:
1. "Python for Data Analysis" by Wes McKinney 2. "Data Science for Business" by Foster Provost and Tom Fawcett 3. "Business Analytics: Data Analysis & Decision Making" by Albright & Winston 4. Online Python and Business Analytics resources: Kaggle, Towards Data Science, etc.

D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMENT
Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)
B. Tech. Data Science Engineering (SEMESTER- VI)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	23DSEU6P01	PCC	Data Engineering	**3**	3	-	-	20	30	50	-	-	100
2	23DSEU6P02	PCC	Machine Learning	**3**	3	-	-	20	30	50	-	-	100
3	23DSEU6P03	PCC	Data Engineering Lab	**1**	-	2	-	-	-	-	25	25	50
4	23DSEU6P04	PCC	Machine Learning Lab	**1**	-	2	-	-	-	-	25	-	25
5	23DSEU6P05	PCC	Data Analytics Tools	**2**	1	2	-	-	-	-	25	25	50
6	23DSEU6M06	MDM-IV	Fundamentals of Business Intelligence	**2**	2	-	-	-	-	50	-	-	50
7	23DSEU6E07	PEC-II	Cyber Security and Forensics	**3**	3	-	-	20	30	50	-	-	100
8	23DSEU6E08		Software Architecture										
9	23DSEU6E09		Internet of Things										
10	23DSEU6E10	PEC-II	Cyber Security and Forensics Tutorial	**1**	-	-	1	-	-	-	25	-	25
11	23DSEU6E11		Software Architecture Tutorial										
12	23DSEU6E12		Internet of Things Tutorial										
13	23DSEU6E13	PEC-III	Blockchain Technology	**3**	3	-	-	20	30	50	-	-	100
14	23DSEU6E14		Cloud Computing										
15	23DSEU6E15		High Performance Computing										
16	23DSEU6E16	PEC-III	Blockchain Technology Lab	**1**	-	2	-	-	-	-	25	-	25
17	23DSEU6E17		Cloud Computing Lab										
18	23DSEU6E18		High Performance Computing Lab										
19	23DSEU6N19	VSEC	Web Application Development - II	**2**	1	2	-	-	-	-	25	50	75
20	23DSEU6D20	AC	Liberal Learning	-	2*	-	-	-	-	-	50*	-	
21	23DSEU6D21	AC	Finishing School Training - VI	-	2*	-	-	-	-	-	50*	-	
			Total	**22**	**16**	**10**	**1**						**700**

HONORS

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/	
1	23DSEU6Z01	Honors	Ethical Hacking	3	3	-	-	20	30	50	-	-	100
2	23DSEU6Z02	Honors	Ethical Hacking Lab	1	-	2	-	-	-	-	25	-	25

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

Course Code:	23DSEU6P01
Course Name:	Data Engineering

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Database Engineering Concepts

Course Description:

Advanced Database Engineering is an extension to database systems. Advanced database focuses and presents the features, benefits of advanced data models like Object oriented & Object relational models. Explores ahead the extension of SQL to PL/SQL to draw the benefits to the database designer & to the developer's community. This course covers NoSQL Databases like Key-Value Database, Document Database, etc.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand and Use the knowledge of PL/SQL in writing queries
CO2	Demonstrate the use of data mining & data warehousing techniques in business data analytics
CO3	Illustrate design, architectures, data storage, distribution &query processing in Parallel & distributed databases.
CO4	Construct a database using the SQL security features.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	**Advanced SQL**	**5 Hours**
Introduction to PL/SQL, PL/SQL Functions & Procedures, Oracle Sequences, Embedded SQL		
Unit 2	**Object-Database Systems**	**6 Hours**
Motivating Example, Structured Data Types, Operations on Structured Data, Encapsulation and ADTs, Inheritance, Objects aIDs, and Reference Types, Database Design for an ORDBMS,ORDBMS Implementation Challenges, OODBMS, Comparing RDBMS, OODBMS, and ORDBMS		
Unit 3	**NoSQL Database Management**	**7 Hours**
Introduction, Data management with distributed databases, ACID and BASE NoSQL Types: Key-Value Database, Document Database, Column Family Database, and Graph Database Comparisonof relational databases and NoSQL		
Unit 4	**Data Warehousing and Data Mining**	**8 Hours**
DATA WAREHOUSING AND DECISION SUPPORT: Introduction to Decision Support, OLAP: Multidimensional Data Model, Multidimensional Aggregation Queries, Finding AnswersQuickly, Data Warehousing, Views and Decision Support, View Materialization. **DATA MINING:** Introduction to Data Mining, Counting Co-occurrences, Mining for Rules,Tree-Structured Rules, Clustering, Similarity Search over Sequences, Incremental Mining andData Streams, Additional Data Mining Tasks		
Unit 5	**Parallel and Distributed Databases**	**8 Hours**
Introduction, Architectures for Parallel Databases, Parallel Query Evaluation, ParallelizingIndividual Operations, Parallel Query Optimization, Introduction to Distributed Databases,Distributed DBMS Architectures, Storing Data in a Distributed DBMS, Distributed Catalog Management, Distributed Query Processing, Updating Distributed Data, Distributed Transactions,Distributed Concurrency Control, Distributed Recovery.		
Unit 6	**Database Security**	**6 Hours**
Introduction to Database Security Issues, Discretionary Access Control Based on Granting andRevoking Privileges, Mandatory Access Control and Role-Based Access Control for MultilevelSecurity, SQL Injection, Privacy Issues, and Preservation, Challenges of Database Security, OracleLabel-Based Security		

Text Books:

1. Oracle® PL/SQL™ by Example FOURTH EDITION BENJAMIN ROSENZWEIG ELENA SILVESTROVA RAKHIMOV(Unit : 1)
2. Database Management System - Raghu Ramakrishnan, Johannes Gehrke - MGH, [4e] (Units: 2,4,5)
3. NoSQL for Mere Mortals- Dan Sullivan- 1st Edition, Pearson Education(Unit-3)
4. Fundamentals of Database Systems -R. Elmasri S. B. Navathe - Addison Wesley-SixthEdition(Unit-6)

Reference Books:

1. Database System Concepts - Silberschatz, Korth, Sudarshan - MGH, 6th Edition
2. Data Mining - Margaret H. Dunham - Pearson Education
3. NoSQL Distilled: A brief guide to merging world of Polyglot persistence - Pramod J. Sadalage and Marin Fowler - Addison Wesley
4. Database Systems, Design, Implementation and Management - Coronel-Morris- Rob - Cengage Learning, [9e]

Course Code:	23DSEU6P02	L	T	P	Credit
Course Name:	Machine Learning	3	0	0	3

Course Prerequsites:

Basic knowledge of linear algebra, probability & statistics, calculus, Python programming, and introductory data science concepts.

Course Description:

This course introduces the fundamental concepts, techniques, and applications of Machine Learning, covering supervised, unsupervised, and reinforcement learning methods, along with model evaluation, tuning, and basic deep learning, to equip students with practical skills for solving real-world data-driven problems using Python-based tools.

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Apply fundamental machine learning algorithms such as regression, classification, and clustering to real-world problems
CO2	Analyze and evaluate model performance using appropriate metrics and validation techniques.
CO3	Implement machine learning solutions using Python libraries
CO4	Demonstrate understanding of advanced topics like neural networks, reinforcement learning etc.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation1 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination [30 Ma	30%	50% Course Contents
3	In Semester Evaluation2 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	nd Semester Examination [50 Marks	50%	100% Course Contents

Course Contents:

Unit 1	**Introduction to Machine Learning**	**5 Hours**
Introduction to AI and ML, Types of Machine Learning: Supervised, Unsupervised, Reinforcement, ML Applications in Real World, Steps in Machine Learning Process, Overfitting & Underfitting, Evaluation Metrics: Accuracy, Precision, Recall, F1 Score		
Unit 2	**Supervised Learning**	**9 Hours**
Linear Regression (Single & Multiple Variable), Logistic Regression, k-Nearest Neighbors (k-NN), Support Vector Machines (SVM), Naïve Bayes Classifier, Decision Trees and Random Forests		
Unit 3	**Unsupervised Learning**	**6 Hours**
Clustering: K-Means, Hierarchical Clustering, Dimensionality Reduction: PCA, LDA, Anomaly Detection, Association Rule Mining (Apriori, FP-Growth)		
Unit 4	**Neural Networks & Deep Learning Basics**	**7 Hours**
Perceptron Model, Activation Functions, Multi-layer Perceptron, Forward and Backward Propagation, Introduction to Deep Learning & CNN basics, Overfitting in Deep Learning & Regularization (Dropout, L2)		
Unit 5	**Model Evaluation and Tuning**	**5 Hours**
Cross-validation Techniques, Confusion Matrix, ROC-AUC Curve, Hyperparameter Tuning: Grid Search, Random Search, Feature Engineering and Selection		
Unit 6	**Advanced Topics & Tools**	**8 Hours**
Reinforcement Learning: Q-learning, Markov Decision Process, Ensemble Methods: Bagging, Boosting (AdaBoost, XGBoost), ML Tools and Libraries: Scikit-learn, TensorFlow, Keras Applications: NLP basics, Image Classification, Ethics in Machine Learning & Bias Mitigation		

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 3rd Edition.

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.

Course Code:	23DSEU6P03
Course Name:	Data Engineering Laboratory

L	T	P	Credit
0	0	2	1

Course Prerequsites:

SQL fundamental

Course Description:

Advanced Database Engineering is an extension to database systems. Advanced database focuses and presents the features, benefits of advanced data models like Object oriented & Object relational models. Explores ahead the extension of SQL to PL/SQL to draw the benefits to the database designer & to the developer's community. This course covers NoSQL Databases like Key-Value Database, Document Database, etc.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand fundamentals of database management systems
CO2	Analyze & construct good database design
CO3	Apply SQL queries to design & manage the database

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	50%	Practical performance, internal POE.
2	End Semester	50%	POE

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Course Contents:	
Assessment No. 1 : Write a simple PL/SQL Program for the following i. Print the sum of “N” numbers ii. Check whether the input number is prime or not.	
Assessment No. 2 : Implement & Demonstrate Declaring, Defining, and Invoking a Simple PL/SQL Function for the below statement. i. Find the Factorial of the number.	
Assessment No. 3 : Implement a PL/SQL Procedure for the following i. Find a Maximum of three numbers using “IN” & “OUT” Parameters ii. Find the square of the Number using the “IN OUT” Parameter	
Assessment No. 4 : Using Oracle Sequence demonstrate creating and dropping of an auto-number field for Customer Table.	
Assessment No. 5 : Demonstrate NoSQL Key-Value Database.	
Assessment No. 6 : Demonstrate No SQL Document Database.	
Assessment No. 7 : Demonstrate Data Control Language Commands	
Assessment No. 8 : Construct star schema. Demonstrate Fact and dimension tables	
Assessment No. 9 : Examine SQL Injections.	
Assessment No. 10 : Demonstrate Object-oriented& Object Relational databases.	
Text Book:	

Course Code:	23DSEU6P04	L	T	P	Credit
Course Name:	Machine Learning Laboratory			2	1

Course Prerequsites:

Basic understanding of Python programming, statistics, linear algebra, and use of libraries

Course Description:

This lab course provides hands-on experience with fundamental machine learning algorithms and techniques, enabling students to implement, train, evaluate, and visualize models using Python and popular libraries, aligned with real-world data science applications.

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Perform data preprocessing and visualization using Python libraries.
CO2	Implement and evaluate supervised and unsupervised learning models.
CO3	Develop and test simple neural network models using various tools

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation [25 Marks]	100%	Experiment, Practical Performance and Oral Exam etc.

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List of Experiments:	
1	Introduction to Python Libraries
2	Implement Linear Regression to predict values
3	Apply Logistic Regression for binary classification
4	Build a k-NN classifier for Iris dataset classification
5	Create and visualize a Decision Tree classifier
6	Use Naïve Bayes for text-based spam email classification
7	Apply K-Means Clustering to customer segmentation
8	Perform PCA on a dataset and plot the principal components
9	Train a simple Neural Network using Keras to classify digits
10	Use Confusion Matrix & Accuracy to evaluate a classification model.

Text Books:

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 3rd Edition
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press
2. Andreas C. Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer

Course Code:	23DSEU6P05
Course Name:	Data Analytics Tools

L	T	P	Credit
1	0	2	2

Course Prerequsites:

Fundamentals of Data Science, Statistics and Probability, Programming Fundamentals (Python/R)

Course Description:

This course provides comprehensive knowledge of various data analytics tools and techniques used in modern data science applications. Students will learn to use industry-standard tools for data manipulation, analysis, visualization, and machine learning implementation.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Implement data manipulation and preprocessing techniques
CO2	Design and develop comprehensive data visualization solutions
CO3	Apply advanced analytics technique to solve complex data science problems
CO4	

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	50%	Practical performance, internal POE.
2	ESE	50%	POE

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Course Contents:		
Unit 1	**Introduction to Data Manipulation and Processing Tools**	**4 Hours**
Introduction to Google Colab and cloud-based analytics platforms, NumPy: Arrays, mathematical operations, broadcasting, and linear algebra functions, Pandas: DataFrames, Series, data import/export (CSV, Excel, JSON, databases), Data cleaning techniques: handling missing values, duplicates, outliers Data transformation: grouping, aggregation, merging, reshaping Working with time series data and date-time operations Introduction to Dask for big data processing		
Unit 2	**Data Visualization Tools and Techniques**	**4 Hours**
Matplotlib: Basic plotting, customization, subplots, and styling, Seaborn: Statistical visualizations, categorical plots, and advanced styling, Plotly: Interactive visualizations, dashboards, and web-based plots, Geographic data visualization with Folium, Introduction to Tableau for business intelligence		
Unit 3	**Advanced Analytics and Specialized Tools**	**6 Hours**
Natural Language Processing with NLTK and spaCy, Image processing with OpenCV and PIL, Web scraping tools: BeautifulSoup, Scrapy, and Selenium, API integration for data collection, Introduction to deep learning with TensorFlow and Keras, Time series analysis with statsmodels and Prophet		
Practical Exercises:		
Exercise 1:	Setting up Google Colab environment and importing libraries	**2 Hours**
Exercise 2:	**Matplotlib: Basic plotting, customization, subplots, and styling**	**2 Hours**
Exercise 3:	Seaborn: Statistical visualizations, categorical plots, and advanced styling	**2 Hours**
Exercise 4:	Plotly: Interactive visualizations, dashboards, and web-based plots	**2 Hours**
Exercise 5:	Geographic data visualization with Folium	**2 Hours**
Exercise 6:	Tableau desktop basics and dashboard creation	**4 Hours**
Exercise 7:	Text preprocessing and sentiment analysis using NLTK/spaCy	**4 Hours**
Exercise 8:	Image manipulation and computer vision tasks with OpenCV	**4 Hours**

Text Books:

1. "Python for Data Analysis" - Wes McKinney (O'Reilly Media) - 2nd Edition (Unit 1)
2. "Python Data Science Handbook" - Jake VanderPlas (O'Reilly Media) (Unit 2)
3. "Hands-On Machine Learning with Scikit-Learn and TensorFlow" - Aurélien Géron (O'Reilly Media) - 2nd Edition (Unit 3)

Reference Books:

1. "Data Visualization with Python and JavaScript" - Kyran Dale (O'Reilly Media)
2. "Natural Language Processing with Python" - Steven Bird, Ewan Klein, Edward Loper (O'Reilly Media)
3. "Learning OpenCV 4" - Adrian Kaehler, Gary Bradski (O'Reilly Media)
4. "Web Scraping with Python" - Ryan Mitchell (O'Reilly Media)
5. "Deep Learning with Python" - François Chollet (Manning Publications)

Course Code:	23DSEU6M06
Course Name:	Fundamentals of Business Intelligence

L	T	P	Credit
2	0	0	2

Course Prerequsites:

Basic knowledge of databases, data structures, and programming fundamentals. Familiarity with spreadsheet tools (e.g., Excel) and introductory statistics is recommended.

Course Description:

This course introduces the core concepts and tools of Business Intelligence, focusing on data analysis, visualization, and decision-making. Students will learn to use BI techniques and software to extract insights

Course Outcomes: After the completion of the course the student will be able to -

CO1	Define basic concepts ,Architecture and data warehousing related concepts of Business Intelligence
CO2	To demonstrate the impact of business reporting, information visualization, and dashboards.
CO3	To apply text analytics and web analytics business intelligence methods to various situations.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE	100%	course contents

Course Contents:

Unit 1	**Introduction to Business Intelligence**	**8 Hours**
A Frame work for Business Intelligence (Bl)- The Architecture of Bl - Benefits of business intelligence- how business intelligence differs from competitive intelligence and knowledge management.		
Unit 2	**Data warehousing**	**6 Hours**
Characteristics of Data Warehousing- Data Marts- Data warehousing process- Data warehousing Architectures – Data Integration and the Extraction, Transformation and Load (ETL) Process- OLAP Versus OLTP- Data warehousing implementation issues – Real time data warehousing		
Unit 3	**Business Reporting, Visual Analytics and Business Performance Management.**	**6 Hours**
Data and Information Visualization – Different types of Charts and Graphs- Emergence of Data visualization and Visual analytics - Performance Dashboard - Balance Score Cards – Dashboards Versus Scorecards - Six Sigma as a performance measurement system.		
Unit 4	**Data mining – Supervised and unsupervised learning.**	**8 Hours**
Data mining concepts and applications – Data mining process – Data mining methods – Classification techniques – Decision trees.Cluster Analysis – Partition and Hierarchical methods, Association rule mining –Data mining software		
Unit 5	**Text Analytics, Text Mining and Sentiment Analysis**	**6 Hours**
Text analytics and Text mining concepts and definition – Text mining process – Text mining tools – Sentiment analysis overview – Sentiment analysis applications – Sentiment analysis process.		
Unit 6	**Web Analytics, Web Mining, and Social Analytics**	**6 Hours**
Web mining overview – Web content and Web structure mining – Search Engines - Search Engine Optimization – Web usage mining – Web analytics maturity model and web analytics tools – Social analytics and social network		

Text Books:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence and Analytics, Pearson 10th edition, 2018

Reference Books:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence, Analytics, and Data Science: A Managerial
Perspective, 4th Edition, Pearson, 2017
2. "Business Intelligence For Dummies" by Swain Scheps.
3. David Loshin Morgan, Kaufman, —Business Intelligence: The Savvy Manager‟s Guide‖, Second Edition, 2012

Course Code:	23DSEU6E07		L	T	P	Credit
Course Name:	Cyber Security and Forensics		3			3

Course Prerequsites:
1. C, C++, Python or Java
2.Understanding of OS concepts (Linux/Windows)
3. Networking Basics
4. Data Structures and Algorithms concepts

Course Description:
This course introduces core concepts of cyber security and digital forensics, covering network protection, threat analysis, legal frameworks, and evidence handling. Students gain practical skills in forensic tools and security measures to counter modern cyber threats.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Identify and describe cyber threats and vulnerabilities
CO2	Apply network security principles and tools to secure communication systems
CO3	Demonstrate knowledge of cyber forensic techniques and tools
CO4	Analyze digital evidence in accordance with legal and ethical frameworks

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:

Unit 1	**Introduction to Cyber Security**	**8 Hours**

1.1 Fundamentals of Cyber Security
1.2 Security frameworks: NIST, ISO27001 and Types of cyber attacks (Phishing, DoS, Ransomware, MITRE Attack etc.)
1.3 Cyber threats and vulnerabilities
1.4 Information Security goals: CIA triad (Confidentiality, Integrity, Availability)
1.5 Security mechanisms and access control models
1.6 Basics of cryptography (Symmetric vs Asymmetric, Hashing, Digital Signatures)

Unit 2	**Network Security**	**8 Hours**

2.1 SIEM basics:QRadar, splunk and Incident Response Life Cycle 2.2 Network Security basics: Protocols(TCP/IP, DNS, HTTP) Ports and attacks (Sniffing, Spoofing, MITM, ARP poisoning) 2.3 Network threats
2.4 Firewalls, Firewall rules and types (packet-filtering, proxy, stateful)
2.5 Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)
2.6 Virtual Private Networks (VPNs)
2.7 Secure socket layer (SSL), HTTPS, EDR Basics
2.8 Wireless network security protocols (WEP, WPA, WPA2)

Unit 3	**Cyber Forensics Fundamentals**	**6 Hours**

3.1 Introduction to Cyber Forensics
3.2 Need for cyber forensics in investigation
3.3 Forensic investigation process (Acquisition, Analysis, Reporting)
3.4 Chain of custody
3.5 Legal and ethical issues in cyber forensics
3.6 Tools used in cyber forensics (FTK, EnCase, Autopsy)

Unit 4	**Digital Evidence and Crime Scene Management**	**6 Hours**

4.1 Types of digital evidence (emails, logs, images, etc.)
4.2 Digital evidence collection and preservation
4.3 Imaging and cloning of digital media
4.4 Evidence handling procedures and documentation
4.5 Investigating disk, memory, mobile, and network-based evidence
4.6 Challenges in digital evidence handling

Unit 5	**Cyber Laws and IT Act**	**6 Hours**

5.1 Overview of Indian IT Act 2000 and amendments
5.2 Legal aspects of digital signatures, electronic records
5.3 Cybercrime and related sections under IPC and IT Act
5.4 Intellectual Property Rights (IPR) in cyberspace
5.5 Cyber ethics and legal frameworks
5.6 Case studies on cybercrime

Unit 6	Emerging Trends and Case Studies	6 Hours

6.1 Cybersecurity in IoT and cloud computing
6.2 Blockchain and security
6.3 Artificial Intelligence in cybersecurity
6.4 Case studies on recent cyber attacks and forensic investigations
6.5 Role of CERT-IN, NCIIPC, and global agencies
6.6 Best practices for securing digital assets

Text Books:

1. Behrouz A. Forouzan – *Cryptography and Network Security*, McGraw-Hill. 2. John Sammons – *The Basics of Digital Forensics*, Syngress/Elsevier. 3. Nina Godbole & Sunit Belpure – *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India.

Reference Books:

1. Nelson, B., Phillips, A., & Steuart, C. – *Guide to Computer Forensics and Investigations*, Cengage Learning.
2. William Stallings – *Cryptography and Network Security*, Pearson Education.
3. Marjie T. Britz – *Computer Forensics and Cyber Crime*, Pearson Education.
4. Chuck Easttom – *Computer Security Fundamentals*, Pearson Education.

Course Code:	23DSEU6E08	L	T	P	Credit
Course Name:	Software Architecture	3			3

Course Prerequsites:

Computer Network, Data Communication, Engg. Mathematics

Course Description:

This course introduces the fundamental principles, patterns, and practices of software architecture. It emphasizes the role of software architecture in software engineering, focusing on architectural styles, design documentation, evaluation methods, and quality attributes.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand the role and importance of software architecture in the software development life cycle.
CO2	Apply architectural styles and patterns to design software systems.
CO3	Analyze and document software architecture using suitable models and tools.
CO4	Evaluate software architecture with respect to quality attributes and business goals.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination	50%	100% course contents

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Course Contents:

Unit 1	**Introduction to Software Architecture**	**6 Hours**
Definition and scope of software architecture, Architecture vs. design vs. implementation, Role of a software architect, Stakeholders and architecture concerns,Architecture business cycle, Types of architectural structures and views		
Unit 2	**Architectural Styles and Patterns**	**8 Hours**
Architectural styles: Layered, Client-Server, Pipe and Filter, Event-Based, Shared Data, Microservices, Architectural patterns: MVC, Broker, Blackboard, Service-Oriented Architecture, Use cases and comparisons of styles, Impact of styles on quality attributes		
Unit 3	**Designing Software Architecture**	**6 Hours**
Design process overview, Mapping functional requirements to architecture, Documenting software architecture, Architecture Description Languages (ADL) overview, Modeling with UML diagrams for architecture		
Unit 4	**Quality Attributes in Architecture**	**7 Hours**
Introduction to quality attributes, Scenarios for performance, modifiability, availability, security, usability, Architectural tactics for quality, Trade-offs and sensitivity points, Constraints and design decisions		
Unit 5	**Architecture Evaluation and Analysis**	**6 Hours**
Need for evaluation, Evaluation methods: ATAM (Architecture Tradeoff Analysis Method), CBAM (Cost Benefit Analysis Method), Risk identification and analysis, Case study-based analysis		
Unit 6	**Architecture Practices & Case Studies**	**7 Hours**
Introduction to Cloud-native and Microservices architecture, Serverless and Event-driven architecture, DevOps influence on architecture, Case studies: Amazon, Netflix, and Google architecture practices, Use of architecture in modern scalable systems,		

Reference Books:

Textbooks:

1. Len Bass, Paul Clements, Rick Kazman – Software Architecture in Practice, 3rd Edition, Addison-Wesley/Pearson
2. Mary Shaw and David Garlan – Software Architecture: Perspectives on an Emerging Discipline, Pearson

References:

1. Rozanski and Woods – Software Systems Architecture
2. George Fairbanks – Just Enough Software Architecture

Course Code:	23DSEU6E09
Course Name:	Internet of Things

L	T	P	Credit
3	0	0	3

Course Prerequsites:

"Computer Networks and Internet fundamentals

Programming skills in C/C++ or Python

Basic understanding of sensors and electronic components"

Course Description:

This course introduces the fundamentals of the Internet of Things (IoT) and its integration with cloud computing. It covers IoT architecture, sensors, microcontrollers (Arduino, ESP32, Raspberry Pi), communication protocols, and cloud platforms such as AWS. Students will learn to interface devices, collect data, and use cloud services for storage and analytics. The course also explores real-world IoT applications in various domains and addresses challenges related to security, privacy, and ethics.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand the fundamental concepts, architecture, and enabling technologies of the Internet of Things (IoT).
CO2	Demonstrate the ability to interface sensors and actuators with microcontrollers and implement basic
CO3	Analyze the use of wireless communication protocols and cloud services in designing scalable IoT solutions.
CO4	Apply data handling and analytics techniques to IoT applications and examine real-world use cases and

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:

Unit 1	**Fundamentals of IoT**	**6 Hours**
Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M		
Unit 2	**IoT Physical Devices and Endpoints**	**8 Hours**
Microcontrollers, Introduction to Arduino board, various boards of Arduino. Arduino Uno : Arduino Uno Pin Layout, Arduino IDE, Arduino programming, ESP32 : ESP32 pin layout, advantages of ESP32 board, Interfacing sensors with microcontroller Raspberry-Pi : Introduction to Raspberry-Pi, installation of raspberry-pi, raspberry pi configuration,Introduction to Python, Interfacing sensors with raspberry pi.		
Unit 3	**Sensors and Protocol**	**7 Hours**
Sensors : Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Gas sensors, Temperature and Humidity Sensor , Motion Detection Sensors, Wireless Bluetooth Sensors,Level Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor, Biometric, Load, Flow, and pressure sensor Accuators: Actuators, Actuator Types, Actuator Characteristics. Protocol : Zigbee, Bluetooth and BLE, Cellular , LoRa and LoRaWAN, Wi-Fi, MQTT Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols		
Unit 4	**IoT Physical Servers and Cloud Offerings**	**7 Hours**
Introduction to Cloud Storage models and communication APIs Web Server – Web server for IoT, Cloud for IoT, AWS services for IoT		
Unit 5	**Data Handling& Analytics**	**7 Hours**
Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications		
Unit 6	**Applications of IoT**	**6 Hours**
Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection, Security and challenges in IoT		

Text Books:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
1. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)",

Reference Books:

1. Daniel Minoli, — “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
2. Internet of Things (A Hands-on Approach)" by Arshdeep Bahga and Vijay Madisetti
3. Introduction to IoT, Sudip Misra, Anandarup Mukherjee, Arjit Roy, CAMBRIDGE UNIVERSITY, PRESS.
4. Internet of Things Hanads on Approach, Ashdreep Bhaga, Vijay Midishetti, Universities Press

Course Code:	23DSEU6E10	L	T	P	Credit
Course Name:	Cyber Security and Forensics Tutorial		1		1

Course Prerequsites:

1. C, C++, Python or Java
2.Understanding of OS concepts (Linux/Windows)
3. Networking Basics
4. Data Structures and Algorithms concepts

Course Description:

This course deals with the theoretical background of Cyber security and Digital Forensics

Course Outcomes: After the completion of the course the student will be able to -

CO1	Analyze and interpret system and network logs to detect potential security incidents.
CO2	Apply packet and malware analysis techniques to identify threats and malicious behavior.
CO3	Evaluate cyber threats using threat intelligence and correlate findings with MITRE ATT&CK techniques.
CO4	Demonstrate the ability to respond to cyber incidents by implementing incident response and security rules.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:
Tutorial 1: Log Analysis-Analyze logs for failed login attempts, brute-force attacks, Web proxy, Firewall, WAF, EDR, Cloud, IPS, Windows, Email gateway(Tools to use: Splunk Free Edition / Qradar)
Tutorial 2: SIEM Use Case- Create a custom correlation rule to detect brute-force login (Tools to use: QRadar Community Edition (CE))
Tutorial 3: Log Filtering & Search- Use filters to extract logs for specific IP, user, or event type(Tools to use-)
Tutorial 4: Packet Analysis- Capture and analyze packets to detect clear-text credentials **(**tools to use- Wireshark**)**
Tutorial 5: Phishing Email Investigation Analyze email headers to detect spoofing/phishing attempts/ URL/ Attachment (tools to use: MXtoolBox/VirusTotal, urlscan.io/Anyrun)
Tutorial 6: Threat Intelligence Lookup- Identify and check malicious IPs/domains using external sources(tools used-VirusTotal, AbuseIPDB, IPVoid)
Tutorial 7: Malware File Analysis (Safe)- Use static and dynamic analysis to inspect a suspicious file (tools used-Any.Run, Hybrid Analysis, VirusTotal)
Tutorial 8: EDR Alert Handling- Investigate malware/behavioral alerts(tools used: CrowdStrike Falcon (demo), SentinelOne (demo))
Tutorial 9: Vulnerability Scanning-Scan a system and generate a vulnerability report(tools used:Nessus Essentials / OpenVAS/ Qualys)
Tutorial 10: MITRE ATT&CK Mapping- Map attack patterns to MITRE techniques(MITRE ATT&CK Navigator (online tool))

Text Books:

1. Behrouz A. Forouzan – *Cryptography and Network Security*, McGraw-Hill. 2. John Sammons – *The Basics of Digital Forensics*, Syngress/Elsevier. 3. Nina Godbole & Sunit Belpure – *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India.

Reference Books:

1. Nelson, B., Phillips, A., & Steuart, C. – *Guide to Computer Forensics and Investigations*, Cengage Learning.
2. William Stallings – *Cryptography and Network Security*, Pearson Education.
3. Marjie T. Britz – *Computer Forensics and Cyber Crime*, Pearson Education.
4. Chuck Easttom – *Computer Security Fundamentals*, Pearson Education.

Course Code:	23DSEU6E11	L	T	P	Credit
Course Name:	Software Architecture Tutorial		1		1

Course Prerequsites:

Software Engineering documentation, Object-oriented programming, design principles, Project Management

Course Description:

This tutorial course is designed to provide hands-on understanding of software architecture principles through guided exercises and case studies. Students will explore architectural styles, patterns, modeling techniques, quality attributes, and evaluation methods. The tutorials focus on real-world problem-solving, system design documentation, and architectural decision-making to bridge theoretical knowledge with practical skills.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand architecture basics, stakeholders, and architecture lifecycle
CO2	Apply architectural styles and patterns
CO3	Document and model architecture effectively
CO4	Evaluate and analyze architecture using quality attributes and trade-offs

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	100%	

Course Contents:	
Assessment No. 1 :Introduction to Software Architecture	**1 Hours**
Define architecture, design vs. implementation, and write an architecture business cycle for a given system	
Assessment No. 2 : Stakeholder Analysis	**1 Hours**
Identify stakeholders and their concerns for an online examination system	
Assessment No. 3 : Architectural Styles	**1 Hours**
Compare and contrast different architectural styles with examples	
Assessment No. 4 : Pattern-Based Design	**1 Hours**
Design a system using MVC or Layered architecture for a Library Management System	
Assessment No. 5 : UML-Based Architecture Modeling	**1 Hours**
Create Use Case and Component Diagrams for an E-Commerce application	
Assessment No. 6 :Architecture Documentation	**1 Hours**
Document architecture using 4+1 view model for a mobile banking app	
Assessment No. 7 : Quality Attribute Scenarios	**1 Hours**
Define and prioritize quality attributes (e.g., performance, security) for a Smart City Dashboard	
Assessment No. 8 :Tactics for Quality Attributes	**1 Hours**
Match architectural tactics to quality attributes using real examples	
Assessment No. 9 : Architecture Evaluation (ATAM)	**1 Hours**
Perform simplified ATAM for a Hospital Management System architecture.	
Assessment No. 10 : Modern Architecture Case Study	**1 Hours**
Analyze microservices-based architecture of Netflix/Amazon and map it to styles and patterns	
Text Book:	
Software Architecture in Practice, Len Bass, Paul Clements, Rick Kazman, 3rd Edition, Addison-Wesley / Pearson	

Course Code:	23DSEU6E12
Course Name:	Internet of Things Lab

L	T	P	Credit
0	1	0	1

Course Prerequsites:

"Computer Networks and Internet fundamentals

Programming skills in C/C++ or Python

Basic understanding of sensors and electronic components"

Course Description:

This course introduces the fundamentals of the Internet of Things (IoT) and its integration with cloud computing. It covers IoT architecture, sensors, microcontrollers (Arduino, ESP32, Raspberry Pi), communication protocols, and cloud platforms such as AWS. Students will learn to interface devices, collect data, and use cloud services for storage and analytics. The course also explores real-world IoT applications in various domains and addresses challenges related to security, privacy, and ethics.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Configure and program microcontrollers like Arduino, ESP32, and Raspberry Pi by interfacing various sensors and actuators.
CO2	Connect IoT devices to cloud platforms and visualize sensor data.
CO3	Implement IoT communication using protocols like MQTT and HTTP.
CO4	Develop a mini-project applying IoT and cloud integration in a real-world use case.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	100%	Assignment, Test, Quiz, Seminar, Presentation, etc.

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List of Experiments

1 Study and setup of Arduino/ESP32 boards and basic programming using IDE
2 Interfacing LED and Push Button with Arduino/ESP32
3 Interfacing Temperature and Humidity sensor (e.g., DHT11) and displaying data
4 Interfacing Ultrasonic sensor for distance measurement
5 Interfacing Gas sensor or Light sensor with ESP32/Arduino and displaying output
6 Interfacing with Actuators – DC Motor/Relay using Arduino/ESP32
7 Introduction to Raspberry Pi: OS Installation, Python Programming Basics
8 Sensor interfacing with Raspberry Pi and sending data over local network
9 Implementing communication between two IoT devices using MQTT protocol
10 Sending sensor data to cloud using ThingSpeak or Blynk platform
11 Using AWS IoT Core for device connection and real-time data visualization
12 Mini-project: Design and develop a complete IoT solution using microcontroller, sensors, cloud connectivity, and a simple dashboard for data monitoring

Text Books:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
1. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)",

Reference Books:

1. Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
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3. Introduction to IoT, Sudip Misra, Anandarup Mukherjee, Arjit Roy, CAMBRIDGE UNIVERSITY, PRESS.
4. Internet of Things Hanads on Approach, Ashdreep Bhaga, Vijay Midishetti, Universities Press

Course Code:	23DSEU6E13
Course Name:	Blockchain Technology

L	T	P	Credit
3			3

Course Prerequsites:

Basics of Programming, networks, and cryptography

Course Description:

This course introduces the fundamentals of blockchain technology and smart contracts. It covers the architecture, cryptographic principles, consensus mechanisms, and key platforms such as Bitcoin and Ethereum. Students will gain hands-on experience in writing and deploying smart contracts using Solidity. The course also explores real-world applications of blockchain across industries like finance, supply chain, and healthcare.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Write, deploy, and test smart contracts using Solidity on Ethereum
CO2	Set up and configure blockchain development environments and tools.
CO3	Develop mini DApps integrating smart contracts for real-world use cases.
CO4	Simulate blockchain transactions and interactions using decentralized tools.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	**INTRODUCTION TO BLOCKCHAIN**	**6 Hours**
Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain -History, Evolution of Blockchain, Definition, Need of Blockchain, Distributed Vs Centralized Vs Decentralized, Public Ledgers : Blockchain as Public Ledgers, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain, Benefits and Challenges of Blockchain Usages		
Unit 2	**BLOCKCHAIN ARCHITECTURE**	**7 Hours**
Operation of Bitcoin Blockchain, Blockchain Design Principles, Components of blockchain, Layered Architecture of Blockchain Ecosystem, Blockchain Architecture – Block, Hash, Distributed P2P, Merkle Tree, Structure of Blockchain- Types of Networks : Distributed Network , P2P Network, Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)etc. How Blockchain Works? Blockchain Demo - How Mining Works? (The NONCE and Cryptographic Puzzle) Immutable Ledger, Hard and Soft Forks, double spending		
Unit 3	**CRYPTO CURRENCY**	**6 Hours**
Bitcoin: Bitcoin and its History, Why use bitcoins? Where and how to buy bitcoins, Bitcoin transactions, How bitcoin transactions work, Bitcoin scripts and wallets. Ethereum: Ethereum Virtual Machine (EVM) – Wallets for Ethereum, Ethereum and Smart Contract, Solidity - Smart Contracts, Ether, Gas DApps , Decentralized Autonomous Organizations (DAO) Compare Bitcoin and Ether		
Unit 4	**SMART CONTRACT AND SOLIDITY FUNDAMENTALS**	**7 Hours**
Smart contracts, features of smart contract, types of Smart contract, advantages and challenges of smartcontract, Solidity: Introduction to solidity, Basic syntax, Data types, Operators, control flow, functions A programming		
Unit 5	**Solidity Advanced**	**7 Hours**
Constructors, inheritance, abstract contracts, interfaces, events, mapping, error handling, libraries		
Unit 6	**DIFFERENT BLOCKCHAIN FRAMEWORKS AND USE CASES**	**6 Hours**
Study of Blockchain Frameworks: Hyperledger, IOTA, Corda, Multichain, Quorum etc. Different use cases of blockchain other than cryptocurrencies		

Text Books:

1. Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions By Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media.
2. Imran Bashir, "Mastering BlockChain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, first edition – 2012
3. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
4. Mastering Ethereum: Building Smart Contracts and DAPPS, by Andreas Antonopoulos, Dr. Gavid Wood, Oreilly Publication
5. Anshul Kaushik, "BlockChain and Crypto Currencies", Khanna Publishing House, Delhi

Reference Books:

1. Learn Ethereum: Build your own decentralized applications with Ethereum and smart contracts by by Xun (Brian) Wu , Zhihong Zou , Dongying Song

Course Code:	23DSEU6E14	L	T	P	Credit
Course Name:	Cloud Computing	3	0	0	3

Course Prerequsites:

Basic knowledge of computer networks, operating systems, and distributed systems.

Course Description:

Cloud Computing course will focus on the evolution of cloud environment, its architecture, types, prominent cloud platform examples, virtualization techniques and migration, docker-container & Kubernetes, security and management.

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Explain the cloud computing architecture, types and models
CO2	Classify the virtualization techniques
CO3	Compare different architectures and platforms of cloud computing.
CO4	Summarize security threats and security measure for cloud computing

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation1 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination [30 Mar	30%	50% Course Contents
3	In Semester Evaluation2 [10 Marks]	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	nd Semester Examination [50 Marks	50%	100% Course Contents

Course Contents:

Unit 1	**Introduction**	**7 Hours**
Definition, Historical Developments, Computing Platforms and Technologies. Building cloud computing environments, Principles of Parallel and Distributed Computing: Parallel versus Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, and Technologies for Distributed Computing.		
Unit 2	**Virtualization**	**7 Hours**
Characteristics, Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization		
Unit 3	**Cloud Computing Architecture**	**7 Hours**
Cloud Reference Model, Types of Clouds – Public, Private, Hybrid and Community cloud, Types of Services – IaaS, PaaS, SaaS, Economics of Clouds, Open Challenges, Public Clouds: Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure.		
Unit 4	**Migration into cloud and Virtual machine Provisioning**	**7 Hours**
Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action, Provisioning in the Cloud Context.		
Unit 5	**Advanced Concepts – Docker, Container and Kubernetes**	**7 Hours**
Introduction to CaaS, Why containers? Difference between Virtualization and Containers. Introduction to Containers, Docker and its architecture (Jain), Understanding Docker Container, Networking. Kuberentes – Introduction, Architecture. (cookbook) Case Study (Any case study available on the Internet such as - IBM, AWS, Google Qwiklabs using Kubernetes, docker container).		
Unit 6	**Cloud Security & Management**	**7 Hours**
Fundamental cloud security – Basic terms and concepts, Threat agents, cloud security threats, case study example. Cloud Management Mechanisms - SLA management and case study. Cloud Security Mechanisms – PKI, IAM and SSO with case studies.		

Text Books:

1. Mastering Cloud Computing - Buyya R, Vecchiola C, Selvi S T, McGraw Hill Education (India), 2013
2. Cloud Computing - Principles and Paradigms - Buyya R, Broberg J, Goscinski A, Wiley,2011
3. Cloud Computing Concepts, Technology & Architecture - Thomas Erl, Zaigham Mahmood, and Ricardo Puttini
4. A to z on Docker: A complete Hands-On Guide to Docker Container – Swapnil Jain
5. Docker Cookbook - Sébastien Goasguen, O'reilly Nov. 2015 First Edition

Reference Books:

1. Cloud Computing Bible - Barrie Sosinsky ,Wiley Publishing Inc. 2011
2. Cloud Native DevOps with Kubernetes – John Arundel and Justin Domingus

Course Code:	23DSEU6E15
Course Name:	High Performance Computing

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Data Structures and Algorithms, Computer Organization and Architecture, Operating Systems

Course Description:

This course introduces students to the concepts, techniques, and tools used in high-performance computing (HPC). Students will learn about parallel and distributed computing architectures, programming models, performance optimization techniques, and real-world applications.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Analyze different parallel computing architectures and select appropriate HPC systems
CO2	Design and implement parallel algorithms using various programming models
CO3	Evaluate and optimize the performance of parallel programs using profiling tools and optimization techniques
CO4	Apply HPC concepts to solve real-world computational problems

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:

Unit 1	**Introduction to Parallel Architectures**	**8 Hours**
Motivation for parallel computing and history, Sequential vs parallel processing, Parallel computer architectures and classifications, Shared-memory multiprocessors and interconnection networks, Distributed-memory multicomputers, SIMD computers and vector processors, Performance metrics and scalability analysis, Parallel programming models overview		
Unit 2	**Parallel Algorithm Design and Analysis**	**7 Hours**
Parallel algorithm design methodology, Task/data decomposition strategies, Foster's parallel algorithm design methodology, Mapping techniques and load balancing, Parallel algorithm complexity analysis, Parallel efficiency and scalability, Case studies: parallel sorting and searching algorithms		
Unit 3	**Message-Passing Programming with MPI**	**8 Hours**
Message-passing programming model, MPI programming basics and environment, Point-to-point communication functions, Collective communication operations, MPI data types and communicators, Performance analysis of MPI programs, Practical applications: Sieve of Eratosthenes, Floyd's algorithm, Matrix-vector multiplication using MPI		
Unit 4	**Advanced MPI Programming and Applications**	**7 Hours**
Monte Carlo methods in parallel, Matrix multiplication algorithms, Solving linear systems of equations, Finite difference methods for PDEs, Parallel sorting algorithms, Fast Fourier Transform implementation, Combinatorial search algorithms, MPI debugging and optimization techniques		
Unit 5	**Shared-Memory Programming with OpenMP**	**6 Hours**
Shared-memory programming model, OpenMP programming fundamentals, Parallel regions and work-sharing constructs, Data environment and variable scoping, Synchronization and critical sections, Performance considerations in OpenMP, Combining MPI and OpenMP (hybrid programming)		
Unit 6	**GPU Computing and Modern HPC Systems**	**7 Hours**
Introduction to GPU computing architecture, CUDA programming model and memory hierarchy, Kernel development and thread management, Performance optimization for GPU computing, Parallel programming patterns and best practices, Modern HPC system architectures, Performance analysis tools and benchmarking, Future trends in high-performance computing		

Text Books:

1. "Parallel Programming in C with MPI and OpenMP" by Michael J. Quinn, McGraw-Hill Education, First Edition, 2003 (Unit 1, Unit 2, Unit 3, Unit 4, Unit 5)
2. "Introduction to High Performance Computing for Scientists and Engineers" by Georg Hager and Gerhard Wellein, CRC Press, First Edition, 2010 (Unit 1, Unit 6)
3. "Programming Massively Parallel Processors: A Hands-on Approach" by David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann, Fourth Edition, 2022 (Unit 6)

Reference Books:

1. "High Performance Computing: Modern Systems and Practices" by Thomas Sterling, Matthew Anderson, and Maciej Brodowicz, Morgan Kaufmann, First Edition, 2017
2. "Parallel Programming: Concepts and Practice" by Bertil Schmidt, Jorge González-Domínguez, Christian Hundt, and Moritz Schlarb, Morgan Kaufmann, First Edition, 2017
3. "High Performance Python: Practical Performant Programming for Humans" by Micha Gorelick and Ian Ozsvald, O'Reilly Media, Second Edition, 2020
4. "Introduction to Parallel Computing" by Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Pearson, Second Edition, 2003

Course Code:	23DSEU6E16
Course Name:	Blockchain Technology Lab

L	T	P	Credit
3			3

Course Prerequsites:

Basics of Programming, networks, and cryptography

Course Description:

This course introduces the fundamentals of blockchain technology and smart contracts. It covers the architecture, cryptographic principles, consensus mechanisms, and key platforms such as Bitcoin and Ethereum. Students will gain hands-on experience in writing and deploying smart contracts using Solidity. The course also explores real-world applications of blockchain across industries like finance, supply chain, and healthcare.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Describe the fundamentals, architecture, and types of blockchain systems.
CO2	Analyze cryptographic techniques and consensus mechanisms used in blockchain.
CO3	Develop smart contracts using Solidity and deploy them on Ethereum-like platforms.
CO4	Evaluate blockchain platforms and applications for real-world problem-solving in various domains.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation	100%	Assignment, Test, Quiz, Seminar, Presentation, etc.

Experiment List

1	Introduction to Blockchain simulators and tools (Ganache, MetaMask, Remix IDE)
2	Setting up Ethereum blockchain environment using Ganache and connecting with MetaMask
3	Creating and deploying a basic smart contract using Solidity in Remix
4	Writing a smart contract for a voting system
5	Implementing a smart contract for a crowdfunding platform
6	Demonstrating a cryptocurrency transfer between accounts using smart contract
7	Managing ownership and access control in smart contracts
8	Testing smart contracts with Truffle framework (optional advanced)
9	Mini project: Develop a DApp with front-end integration

Text Books:

1. Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions By Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media.
2. Imran Bashir, "Mastering BlockChain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, first edition – 2012
3. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
4. Mastering Ethereum: Building Smart Contracts and DAPPS, by Andreas Antonopoulos, Dr. Gavid Wood, Oreilly Publication
5. Anshul Kaushik, "BlockChain and Crypto Currencies", Khanna Publishing House, Delhi

Reference Books:

1. Learn Ethereum: Build your own decentralized applications with Ethereum and smart contracts by by Xun (Brian) Wu , Zhihong Zou , Dongying Song

Course Code:	23DSEU6E17	L	T	P	Credit
Course Name:	Cloud Computing Laboratory			2	1

Course Prerequsites:

Basic understanding of computer networks, operating systems, and programming skills in Python or Java.

Course Description:

This laboratory course offers hands-on experience with fundamental cloud computing services and tools. Students will learn to work with virtual machines, cloud storage, databases, web hosting, and basic security features on platforms like AWS, Azure, or Google Cloud. The course aims to develop practical skills in deploying, managing, and monitoring cloud-based applications and resources.

Course Outcomes:	After the completion of the course the student will be able to -
CO1	Use public cloud environment
CO2	Build virtual machines using virtualization techniques
CO3	Make use of containers for software deployment

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation [25 Marks]	100%	Experiment, Practical Performance and Oral Exam etc.

List of Experiments:	
1	Use Google Collab book for writing program
2	Use google APIs to access google cloud services
3	Create Virtual Machine using emulator - emue and virtual library
4	Create Virtual Machines using KVM library - paravirtualized machine
5	Create bare-metal virtual machine
6	Create container using lxc
7	Create a container using docker - docker desktop , docker CLI
8	Networking of Docker Containers
9	Building Docker Image
10	Check the usage reports or activity logs of your cloud resources.

Text Books:

1. Mastering Cloud Computing - Buyya R, Vecchiola C, Selvi S T, McGraw Hill Education (India), 2013
2. Cloud Computing - Principles and Paradigms - Buyya R, Broberg J, Goscinski A, Wiley,2011
3. Cloud Computing Concepts, Technology & Architecture - Thomas Erl, Zaigham Mahmood, and Ricardo Puttini
4. A to z on Docker: A complete Hands-On Guide to Docker Container – Swapnil Jain
5. Docker Cookbook - Sébastien Goasguen, O'reilly Nov. 2015 First Edition

Reference Books:

1. Cloud Computing Bible - Barrie Sosinsky ,Wiley Publishing Inc. 2011
2. Cloud Native DevOps with Kubernetes – John Arundel and Justin Domingus

Course Code:	23DSEU6E18
Course Name:	High Performance Computing Laboratory

L	T	P	Credit
0	0	2	1

Course Prerequsites:

Programming in C/C++, Basic knowledge of Linux/Unix systems

Course Description:

This laboratory course provides hands-on experience in parallel and high-performance computing. Students will implement parallel algorithms using various programming models including OpenMP, MPI, and CUDA.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Implement and analyze parallel programs using shared memory programming model (OpenMP)
CO2	Develop distributed memory parallel applications using Message Passing Interface (MPI)
CO3	Design and optimize GPU-based parallel programs using CUDA programming model
CO4	Evaluate performance of parallel programs and apply optimization techniques using profiling tools

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	100%	Assignment, Test, Quiz, Seminar, Presentation, etc.

Course Contents:		
Experiment 1:	**Introduction to Parallel Computing Environment**	**2 Hours**
Objective: Set up and familiarize with parallel computing environment Tasks: Installation and configuration of GCC with OpenMP support Setting up MPI environment (OpenMPI/MPICH) Basic Linux commands for HPC environment Writing and compiling first "Hello World" programs in OpenMP and MPI Understanding system architecture using hardware detection tools		
Experiment 2:	**Shared Memory Programming with OpenMP - Basic Constructs**	**2 Hours**
Objective: Implement basic OpenMP parallel programs Tasks: Parallel regions and thread creation Work-sharing constructs: parallel for, parallel sections Variable scoping: private, shared, firstprivate, lastprivate Parallel computation of π using numerical integration Matrix addition and multiplication using OpenMP Performance analysis with different thread counts		
Experiment 3:	**OpenMP Synchronization and Advanced Constructs**	**4 Hours**
Objective: Implement synchronization mechanisms in OpenMP Tasks: Critical sections and atomic operations Reduction operations for parallel summation Barrier synchronization Producer-consumer problem using OpenMP Parallel sorting algorithms (Bubble sort, Quick sort) Debugging race conditions and deadlocks		
Experiment 4:	**Message Passing Programming with MPI - Fundamentals**	**4 Hours**
Objective: Develop basic MPI applications Tasks: MPI initialization, rank identification, and finalization Point-to-point communication: MPI_Send and MPI_Recv Ring communication pattern implementation Parallel computation of factorial using MPI Master-slave architecture for parallel task distribution Performance comparison with sequential version		
Experiment 5:	**MPI Collective Communication Operations**	**4 Hours**
Objective: Implement collective communication in MPI Tasks: Broadcast operation (MPI_Bcast) for data distribution Scatter and Gather operations for data decomposition Reduce operations for parallel reductions Allreduce for global computations Parallel matrix-vector multiplication using MPI Implementation of parallel prefix sum algorithm		

Experiment 6:	Introduction to GPU Computing with CUDA	4 Hours

Objective: Develop basic CUDA programs for GPU computing
Tasks:
CUDA environment setup and device query
Writing first CUDA kernel for vector addition
Memory management: host-device data transfer

Text Books:

1."Parallel Programming in C with MPI and OpenMP" by Michael J. Quinn, McGraw-Hill Education, First Edition, 2003
2."Programming Massively Parallel Processors: A Hands-on Approach" by David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann, Fourth Edition, 2022

Reference Books:

1. "Using OpenMP: Portable Shared Memory Parallel Programming" by Barbara Chapman, Gabriele Jost, and Ruud van der Pas, MIT Press, First Edition, 2007
2. "Parallel Programming with MPI" by Peter Pacheco, Morgan Kaufmann, First Edition, 1997
3. "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs" by Shane Cook, Morgan Kaufmann, First Edition, 2012
4. "High Performance Computing: Programming and Applications" by John Levesque and Gene Wagenbreth, CRC Press, First Edition, 2010

Course Code:	23DSEU6N19
Course Name:	Web Application Development - II

L	T	P	Credit
1		2	2

Course Prerequsites:

Basic Programming Knowledge, Basic knowledge of HTML, CSS, and JavaScript, Introduction to Java, Basic knowledge of relational databases

Course Description:

This course provides comprehensive training in building full-stack web applications using React for the frontend and Spring Boot for the backend. Students will learn to design responsive user interfaces, develop RESTful APIs, and integrate both ends to create modern web applications. Emphasis is placed on component-based development, routing, state management, secure API development, and deployment.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Design and implement dynamic user interfaces using React and its component-based architecture.
CO2	Develop secure and scalable backend services using Spring Boot and RESTful APIs.
CO3	Integrate frontend and backend technologies to build full-stack web applications.
CO4	Deploy and test full-stack applications with effective state management and secure API communication.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	100% course contents

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Course Contents:

Unit 1	**Introduction to React**	**3 Hours**
Introduction to SPA and React.js JSX and Virtual DOM Functional Components and Props State and Lifecycle Methods Handling Events in React		
Unit 2	**Advanced React Features**	**5 Hours**
Conditional Rendering and Lists Forms and Input Handling Lifting State Up React Hooks: useState, useEffect Context API and Custom Hooks		
Unit 3	**React Routing and State Management**	**6 Hours**
React Router: Navigation, Route Parameters, Nested Routing Global State Management: useReducer, Context API Introduction to Redux (optional) API Calls using Axios / Fetch Error Handling and Loading States		
Unit 4	**Introduction to Spring Boot**	**5 Hours**
Overview of Spring Framework and Spring Boot Spring Boot Architecture and Dependencies (Maven/Gradle) Building REST APIs with Spring Boot		
Unit 5	**Data Persistence and Security**	**5 Hours**
Spring Data JPA and Hibernate CRUD Operations using Repositories Connecting to MySQL/PostgreSQL Spring Boot Security Basics (JWT/OAuth2 overview) Role-Based Access Control (RBAC)		
Unit 6	**Full Stack Integration and Deployment**	**4 Hours**
Connecting React Frontend with Spring Boot Backend Handling CORS and API Authentication Environment Configuration and .env files Deployment of application Project: Full-stack CRUD application with secure login		

Text Books:

Reference Books:

1. Learn Ethereum: Build your own decentralized applications with Ethereum and smart contracts by by Xun (Brian) Wu , Zhihong Zou , Dongying Song

Experiment List	
1	Setup React Development Environment (Node.js, npm, VS Code) and create a basic React app
2	Create React components using JSX, Props, and State
3	Build forms in React and handle form events and validations
4	Implement routing in React using React Router
5	Use React Hooks (useState, useEffect) for state and side effects
6	Setup Spring Boot project using Spring Initializr and build a basic REST API
7	Develop CRUD operations using Spring Boot and MySQL/PostgreSQL
8	Implement exception handling and validation in Spring Boot APIs
9	Connect React frontend with Spring Boot backend using Axios
10	Implement user login and role-based authentication (Spring Security + JWT)
11	Manage environment variables and integrate .env in frontend/backend
12	Final mini-project: Develop and deploy a full-stack web app (e.g., Task Manager, E-Commerce Admin, Event Manager)