KUMARAGURU COLLEGE OF TECHNOLOGY

An autonomous Institution affiliated to Anna University, Chennai.

COIMBATORE – 641 049

Master of Computer Applications

REGULATION 2024

I to IV Semesters

(Applicable to the students admitted during the academic year 2024 - 25 ONLY)

Department of Computer Applications

VISION

- To be a leader in computing education and research, equipping students with the skills to thrive in the technology field and contribute to the growth of society and the economy.

MISSION

- Deliver high-quality education and practical skills in computing and technology, preparing students to meet industry demands and excel in their careers.
- Encourage innovation, critical thinking, and research in computing, enabling students to solve real-world problems and contribute to technological advancements.
- Nurture socially responsible and ethical professionals who can lead with integrity and contribute to the sustainable development of society and the economy.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of Master of Computer Applications Program are to:

PEO1: Equip with strong computing skills and innovation of software products to meet industry needs.

PEO2: Provide exposure to cutting edge technologies and training to work on multidisciplinary projects in a team.

PEO3: Prepare for life-long learning through professional activities; adapt themselves with ease to new technologies, while exhibiting ethical and professional standards.

PROGRAM OUTCOMES (POs)

On successful completion of the program:

PO1: **Foundation Knowledge** - Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

PO2: Problem Analysis- Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.

PO3: Development of Solutions - Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.


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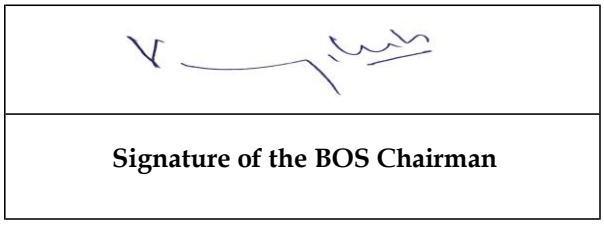
PO4: Modern Tool Usage - Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5: Individual and Teamwork- Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6: Project Management and Finance - Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
PO7: Ethics - Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8: Life-long learning - Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.



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KUMARAGURU COLLEGE OF TECHNOLOGY

DEPARTMENT OF COMPUTER APPLICATIONS

REGULATION 2024

Master of Computer Applications - Curriculum

(Applicable to students admitted in the year 2024 ONLY)

Semester I

S. No.	Course Code	Course Title	Course Mode	Course Type	L	T	P	J	C
1	24CAI501	Data Structures and Algorithms	Embedded	PC	3	0	2	0	4
2	24CAI502	Database Management Systems	Embedded	PC	3	0	2	0	4
3	24CAI503	Object Oriented Programming	Embedded	PC	3	0	2	0	4
4	24CAT504	Operating Systems	Theory	PC	3	0	0	0	3
5	24CAT505	Cloud Computing	Theory	PC	3	0	0	0	3
6	24MAI504	Probability and Statistics for Data Analysis	Embedded	BS	3	0	2	0	4
7	24HST506	Professional Communication Strategies	Theory	HS	2	0	0	0	2
								Total Credits	**24**
								Total Contact Hours/week	**28**

Semester II

S. No.	Course Code	Course Title	Course Mode	Course Type	L	T	P	J	C
1	24CAT506	Cyber Security	Theory	PC	3	0	0	0	3
2	24CAI507	Automation and Artificial Intelligence	Embedded	PC	2	0	2	0	3
3	24CAI508	Full Stack Application Development	Embedded	PC	3	0	2	0	4
4	24CAI509	Data Analysis and Visualization	Embedded	PC	3	0	2	0	4
5	24CAT510	Finance, Economics & Marketing	Theory	HS	3	0	0	0	3
6	24CAC0--	Professional Elective I	Embedded	PE	2	0	2	0	3
7	24CAE0--	Professional Elective II	Theory	PE	3	0	0	0	3
								Total Credits	**23**
								Total Contact Hours/week	**27**

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Semester III									
S. No.	**Course Code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24CAT601	Software Project Management	Theory	PC	3	0	0	0	3
2	24CAC0--	Professional Elective III	Embedded	PE	2	0	2	0	3
3	24CAC0--	Professional Elective IV	Embedded	PE	2	0	2	0	3
4	24CAC0--	Professional Elective V	Embedded	PE	2	0	2	0	3
5	OE	Open Elective	Theory	OE	3	0	0	0	3
6	24CAJ602	Internship*	Project	PW	0	0	0	6	2
								Total Credits	**17**
								Total Contact Hours/week	**18**
* - Internship should begin during summer vacation (At the end of semester II) for 4 weeks.									
Semester IV									
S. No.	**Course Code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24CYS601	Principles of Sustainability and Environmental Science	MOOC**	HS	1	0	0	0	1
2	24CAJ604	Project Work	Project	PW	0	0	0	30	15
								Total Credits	**16**
								Total Contact Hours/week	**31**
** - The course will be offered as MOOC through online mapped to coursera.									

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Professional Electives – Specialization track

S. No.	Specialization track	Course Code	Course Name	Course Type	L	T	P	J	Credit
1	**Extended Reality**	24CAC601	3D Modeling and Game Design	Embedded - Theory & Project	2	0	0	2	**3**
2		24CAC602	Augmented Reality and Virtual Reality Application Development	Embedded - Theory & Project	2	0	0	2	**3**
3		24CAE603	Advanced Metaverse Technologies	Theory	3	0	0	0	**3**
4		24CAC604	Game Programming	Embedded - Theory & Lab	2	0	2	0	**3**
5	**IoT, Edge, UAV**	24CAC605	Embedded Systems for IoT	Embedded - Theory & Lab	2	0	2	0	**3**
6		24CAC606	IoT Systems Design	Embedded - Theory & Project	2	0	0	2	**3**
7		24CAC607	3D Printing	Embedded - Theory & Lab	2	0	2	0	**3**
8		24CAC608	IoT Application Development	Embedded - Theory & Lab	2	0	2	0	**3**
9		24CAC609	Robotic Operating Systems	Embedded - Theory & Lab	2	0	2	0	**3**
10		24CAE610	Software Defined Vehicle	Theory	3	0	0	0	**3**
11	**Cyber Security**	24CAC611	Ethical Hacking and Network Defence	Embedded - Theory & Lab	2	0	2	0	**3**
12		24CAE612	Cyber Ethics and Laws	Theory	3	0	0	0	**3**
13		24CAC613	Secure Software Development	Embedded - Theory & Lab	2	0	2	0	**3**

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14		24CAC614	Network Security Administration	Embedded - Theory & Lab	2	0	2	0	**3**
15		24CAC615	Digital Forensics	Embedded - Theory & Lab	2	0	2	0	**3**
16	**Automation and Artificial Intelligence**	24CAC616	Deep Learning	Embedded - Theory & Lab	2	0	2	0	**3**
17		24CAC617	Computer Vision	Embedded - Theory & Lab	2	0	2	0	**3**
18		24CAC618	Natural Language Processing	Embedded - Theory & Lab	2	0	2	0	**3**
19		24CAC619	Generative AI	Embedded - Theory & Lab	2	0	2	0	**3**
20		24CAE620	Responsible AI	Theory	3	0	0	0	**3**
21	**Data Science, Analytics and Visualization**	24CAC621	Principles of Data Science	Embedded - Theory & Lab	2	0	2	0	**3**
22		24CAC622	Data Processing Techniques	Embedded - Theory & Lab	2	0	2	0	**3**
23		24CAC623	Data Modelling	Embedded - Theory & Lab	2	0	2	0	**3**
24		24CAC624	Business Intelligence for Decision Making	Embedded - Theory & Lab	2	0	2	0	**3**
25		24CAE625	Data Ethics and Privacy	Theory	3	0	0	0	**3**
26	**Network and Distributed Computing**	24CAC626	Smart Contract Development	Embedded - Theory & Lab	2	0	2	0	**3**
27		24CAE627	Decentralized Finance	Theory	3	0	0	0	**3**

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28	**Cloud Computing**	24CAC628	Virtualization and Resource Management	Embedded - Theory & Lab	2	0	2	0	**3**
29		24CAC629	Cloud Infrastructure and Architecture	Embedded - Theory & Lab	2	0	2	0	**3**
30		24CAC630	Cloud Storage Management	Embedded - Theory & Lab	2	0	2	0	**3**
31		24CAC631	Cloud Application Development	Embedded - Theory & Project	2	0	0	2	**3**
32		24CAC632	Cloud Security	Embedded - Theory & Lab	2	0	2	0	**3**
33		24CAC633	Cloud Automation	Embedded - Theory & Project	2	0	0	2	**3**
34	**Web and Software Development**	24CAC634	UI and UX Design	Embedded - Theory & Lab	2	0	2	0	**3**
35		24CAC635	Principles of DevOps	Embedded - Theory & Lab	2	0	2	0	**3**

Open Electives									
S. No.	**Course code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24IEO074	Modern Financial Strategies and Innovations	Theory	OE	3	0	0	0	3
2	24IEO075	Sports Analytics and Emerging Technologies	Theory	OE	3	0	0	0	3
3	24IEO076	Healthcare Innovation and Technology	Theory	OE	3	0	0	0	3
4	24IEO077	Corporate Strategy and Innovation	Theory	OE	3	0	0	0	3
5	24IEO078	Gamification and Gaming	Theory	OE	3	0	0	0	3
6	24IEO079	Environmental Innovations and Management	Theory	OE	3	0	0	0	3

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Semester-wise Credits	
Semester - I	24
Semester - II	23
Semester - III	17
Semester - IV	16
Total Credits	**80**

Course Types	Credits
Basic Science (BS)	4
Humanities and Social Sciences (HS)	6
Professional Core (PC)	35
Professional Electives (PE)	15
Project/Internship (PW)	17
Open Elective (OE)	3
Total Credits	**80**

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SEMESTER I

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24CAI501	DATA STRUCTURES AND ALGORITHMS	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,9,11			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Develop a strong foundation in basic data structures.
2	Learn to analyze the efficiency of algorithms using time and space complexity.
3	Implement data structures in both static and dynamic environments.
4	Gain proficiency in implementing and analyzing searching, sorting and hashing techniques.
5	Apply data structures and algorithms to solve complex real-world problems.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the fundamental concepts and the implementation of algorithms in problem-solving contexts.	U
CO 2	Apply linear and non-linear data structures in various practical applications.	Ap
CO 3	Analyze the representation of different types of data structures and implement them in hierarchical data management.	An
CO 4	Analyze the efficiency of various algorithms and evaluate their performance for efficient memory usage and algorithmic performance in solving problems.	An
CO 5	Develop programs by applying various techniques to optimize data organization and retrieval.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3		2	2				
2		3	3					2
3		2						
4		3	2					
5							3	

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Course Content

ALGORITHM ANALYSIS Fundamentals of Algorithm Problem Solving - Fundamentals of Analysis of Algorithm - Efficiency- Analysis Framework - Asymptotic Notations-Mathematical Analysis of Recursive and Non-recursive Algorithms-Analysis of Algorithm-Time Complexities.	**9 Hours**
ARRAYS AND DYNAMIC MEMORY IMPLEMENTATION Arrays: Representation-Operations on Arrays-Linked List: Basic Concepts and Operations-Types of Linked List: Singly Linked List - Doubly List - Stack: Definition-Operations on Stack-Static and Dynamic Implementation of a Stack-Recursion using Stack - Queue: Definition-Operations on Queue-Static and Dynamic Implementation of a Queue. **Practical Component** • Experiments related to Arrays, Linked lists, Stacks and Queues.	**9 Hours** **8 Hours**
TREES Trees: Terminologies-Sequential and Linked Representation-Implementation- Binary Tree-Properties-Binary Tree Traversals-Binary Search Tree: Operations- B-trees: Definition, Operations-Applications of Trees. **Practical Component** • Experiments related to Tees and Binary Trees.	**9 Hours** **6 Hours**
GRAPHS Graphs: Introduction –Terminology-Representation of Graph-Graph Traversals: Depth-First and Breadth-First Traversal-Applications of Graphs-Transitive Closure: Warshall's Algorithm-Shortest Path Algorithms: Dijkstra's Algorithm-Floyd's Algorithm-Minimum Spanning Tree: Prim's and Kruskal's Algorithms. **Practical Component** • Experiments related to Graph traversals, Transitive Closure, Shortest Path and Minimum Spanning Trees.	**9 Hours** **8 Hours**
SORTING AND HASHING Sorting: Insertion Sort, Quick Sort, Merge Sort, Heap Sort - Searching: Linear and Binary Search-Analysis - Hashing: Operations-Hash Table: Hash Functions, Implementation, Collision Resolution and Overflow Handling Techniques, Linear Open Addressing, Chaining. **Practical Component** • Implementation of Sorting, Searching and Hashing Techniques.	**9 Hours** **8 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:75

Learning Resources

Textbooks

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017.
2. Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2006.

Reference books/ Web Links

1. Thomas H. Cormen, Charles E, Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", The MIT Press, Third Edition, 2009.

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2. Jean Paul Trembly, Paul G Sorenson, “An Introduction to Data Structures with Applications”, Tata McGraw Hill, 2017.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed,” Fundamentals of Data Structures in C”, University Press, 2012.

Online Resources

1. https://nptel.ac.in/courses/106102064

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.V. Vijilesh, Dr.V.Geetha Dept. of Computer Applications	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAI502	DATABASE MANAGEMENT SYSTEMS	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Understand database architecture, relational structures, ER model, and SQL operations.
2	Learn efficient database design, normalization (1NF to BCNF), and MySQL integration.
3	Master physical design, transaction concepts, concurrency control, and recovery mechanisms.
4	Explore distributed, multimedia, blockchain, and cloud databases, focusing on mobile applications.
5	Study NoSQL databases like MongoDB, focusing on key-value and document-based models.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand fundamental database concepts and architecture, including relational and NoSQL systems, to support data management needs in various applications.	U
CO 2	Apply relational database design principles, including normalization and SQL operations, to effectively structure and query databases.	Ap
CO 3	Analyze different database technologies to select appropriate solutions for diverse organizational needs.	An
CO 4	Implement concurrency control techniques and recovery mechanisms to achieve fault tolerance in database management systems.	Ap
CO 5	Develop database systems using SQL and NoSQL technologies, ensuring efficient data storage, retrieval, and transaction management across various platforms.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2						2
2			3					
3		2		2				
4			2			2		
5	3							3

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Course Content

INTRODUCTION TO DATABASES Introduction – Database Architecture – Structure of Relational Databases – Database Schema – Schema Diagrams – Relational Query Languages – Keys – Basic Structure of Queries and SQL Operations – Integrity Constraints – ER Model. **Practical Component** • Execute Data Definition Language (DDL) and Data Manipulation Language (DML) commands. • Implement Data Query Language (DQL). • Implement Join Operations.	**9 Hours** **8 Hours**
DATABASE DESIGN Relational Database Design – First Normal Form – Second Normal Form – Third Normal Form - Boyce - Codd Normal Form – Case Study: Normalization Process – Front end and Back end – MySQL – Connectivity using ODBC/JDBC. **Practical Component** • Create Database Objects • Execute Complex and Sub Queries	**9 Hours** **7 Hours**
DATABASE IMPLEMENTATION Physical Database Design and Tuning – Database Transaction: Transaction Concept and State – Concurrency Control: Two-Phase Locking Protocol – Recovery: Failure Classification – Log Based Recovery – Shadow Paging. **Practical Component** • Demonstrate Data Control Language (DCL) and Transaction Control Language (TCL) commands • Execution of PL/SQL Commands • Record Management using Cursors and Functions	**9 Hours** **8 Hours**
EMERGING TECHNOLOGIES AND APPLICATIONS Distributed Databases: Concepts – Database Design and Types – Database Applications in Mobile Communication – Multimedia Databases – Blockchain Databases – Cloud Databases.	**9 Hours**
NoSQL Introduction – Aggregate Data Model – Distribution Model – NoSQL Implementation: Key Value Database – Document Database – Graph based Database - MongoDB. **Practical Component** • CRUD Operations in NoSQL • Indexing and Aggregation Framework in NoSQL	**9 Hours** **7 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:75

Learning Resources

Textbooks

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", 7th Edition, Tata McGraw Hill International Edition, 2019.
2. Pramod Kumar J. Sadalage and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Addison Wesley Professional, 2012.

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Reference books/ Web Links

1. R. Elmasri and S.B. Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson Education, 2016.
2. Batra, Shashank., Dang, Sachin., “NoSQL Database for Beginners”, BPB Publications, New Delhi ,2016.

Online Resources

1. Database Management Essentials - https://www.coursera.org/learn/database-management
2. Oracle Database Concepts https://docs.oracle.com/en/database/oracle/oracledatabase/index.html

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. M. Manikantan, Dept. of Computer Applications

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/082024

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24CAI503	OBJECT ORIENTED PROGRAMMING	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,8,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Introduce Java programming fundamentals, focusing on object-oriented principles, exception handling, and GUI development for a strong software design foundation.
2	Develop proficiency in utilizing advanced Java frameworks, enabling students to create scalable and modular software solutions that meet industry standards.
3	Foster the ability to integrate database technologies with Java-based web applications, ensuring students can manage backend data effectively within software projects.
4	Develop analytical skills by evaluating Java libraries and frameworks to address software challenges like GUI and network programming.
5	Provide practical experience in distributed objects and network programming through case studies, allowing students to apply performance optimization techniques in real-world scenarios.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the core concepts of Java programming, including object-oriented principles, exception handling, and GUI to build a solid foundation in software development.	U
CO 2	Apply advanced frameworks to develop modular, scalable, and efficient Java-based software solutions.	Ap
CO 3	Apply various technologies to connect and manipulate databases, demonstrating the ability to integrate backend data management with web applications.	Ap
CO 4	Analyze the effectiveness of different Java frameworks and libraries in addressing specific software development challenges, including GUI design and network programming.	An
CO 5	Evaluate distributed objects and network programming techniques to enhance application performance and scalability, using case studies and real-world examples.	E

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2		2				
2	3		3	3				1
3	3		2	2				
4	2		3	3				
5	2			3				

Course Content

FUNDAMENTALS OF OBJECT-ORIENTED PROGRAMMING Overview of Java – Java Fundamentals: Classes, Objects, Methods and Strings – Methods: A Deeper Look – Arrays and Array List – Classes and Objects: A Deeper Look – Inheritance – Polymorphism – Interfaces – Packages – Exception Handling. **Practical Component** • Experiments related to Class and Object declaration, Access Control, Flow control statements, exception handling, and core OOP concepts such as inheritance, polymorphism, and interfaces.	**9 Hours** **6 Hours**
GUI, I/O AND NETWORK PROGRAMMING Abstract Window Toolkit (AWT) – Strings, Characters and Regular Expressions – Files, Streams and Objects Serialization – Generic Collections – Generic Classes and Methods – Networking: Manipulation URLs – Reading Web Pages – Using Stream Sockets – Datagrams – Multicasting – Multicasting Sockets. **Practical Component** • Experiments related to AWT for GUI development, string manipulation, file handling, generic collections, and networking with URLs, web pages, and sockets.	**9 Hours** **6 Hours**
DISTRIBUTED OBJECTS JSON – AJAX Enabled Rich Internet Applications with JSON – Java Mail API – SMTP, POP3 & IMAP. **Practical Component** • Experiments related to JSON, AJAX for rich internet applications, Java Mail API, and protocols like SMTP, POP3, and IMAP	**9 Hours** **6 Hours**
JDBC AND WEB APPLICATION DEVELOPMENT Servlet – Servlet Architecture – Servlet lifecycle – Generic Servlet – HTTP Servlet – Server-Side Including – Overview of JSP – JSP Components – Bean – Session Tracking - Accessing Databases with JDBC – Basics – Manipulating Databases with JDBC.	**9 Hours**

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Practical Component • Experiments related to servlet architecture and lifecycle, generic and HTTP servlets, JSP components and beans, session tracking, and accessing and manipulating databases with JDBC.	**6 Hours**
ADVANCED FRAMEWORKS Advanced Frameworks – MVC Frameworks – Hibernate- Using Annotations – Hibernate Query Language – Object Relational Mapping – Spring Framework – JMF- Case Studies. **Practical Component** • Experiments related to advanced frameworks, including MVC frameworks, Hibernate with annotations and HQL, object-relational mapping, the Spring Framework, and Java Media Framework.	**9 Hours** **6 Hours**

Theory Hours:45	**Tutorial Hours: 0**	**Practical Hours: 30**	**Project Hours: 0**	**Total Hours:75**

Learning Resources

Textbooks

1. A P Putambekar, "Object Oriented Programming", 4th Edition, Technical Publications,2022.
2. Herbert Schildt," The Complete Reference – Java 2". 12th Edition, Tata McGraw Hill,2020.

Reference books/ Web Links

1. Joyce Farrell,"Java Programming",10th Edition, Cengage Learning, 2022.
2. Y.Daniel Liang,"Intro to Java Programming, Comprehensive Version",10th Edition, Pearson Publications,2020.
3. Paul J.Deitel, Harvey Deitel, "Java How to Program", Eleventh Edition, Pearson,2017.
4. Paul J.Dietel, Harvey Dietel, Abbey Dietel, "Internet and World Wide Web", Fifth Edition, Pearson Education, 2018.

Online Resources

1. https://docs.oracle.com/javase/tutorial

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. N. Jayakanthan, Dept. of Computer Applications

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAT504	OPERATING SYSTEMS	L	T	P	J	C
		3	0	0	0	3
PC		SDG	4,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Understand the structure, operations, and management principles of operating systems, with a focus on Linux and open-source OS concepts.
2	Introduce process management techniques, including process scheduling, inter-process communication, and threading in Linux.
3	Explore process coordination mechanisms, such as synchronization, deadlock prevention, and classic synchronization problems.
4	Examine memory and I/O management strategies, disk scheduling algorithms, and file systems, with real-world case studies like the Linux kernel and Android OS.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the core components and functions of operating systems.	U
CO 2	Apply process management techniques to manage and schedule processes effectively.	Ap
CO 3	Analyze different mechanisms for process synchronization and deadlock management, in solving synchronization problems.	An
CO 4	Implementation of appropriate memory management techniques in operating systems.	Ap
CO 5	Analyze and apply core operating system concepts and techniques through case studies, focusing on process management, synchronization, and memory management.	E

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3							
2	3	2						
3	3	3	3					
4	3	3	3					
5								2

Course Content

INTRODUCTION Operating Systems – Structure – Operations – Process Management – Memory Management – Secondary Storage Management – Protection and Security – Operating System Services – Linux OS – Open-Source OS-Shell-Kernel – File System – Case Study: Evolution of Linux OS.	**8 Hours**
PROCESS MANAGEMENT Process Concepts – Process Scheduling – Operations on Processes – Inter Process Communication in Linux – Pipes – Shared Memory – Message Queues – Threads – Multi-threading Model – Libraries – Issues – CPU Scheduling – Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Problems – Case Study: Process Scheduling in the Linux Kernel.	**8 Hours**
PROCESS COORDINATION Process Synchronization – Critical Section Problem – Peterson's Solution - Synchronization Hardware – Semaphores – Classic Problem of Synchronization – Monitors – Deadlock – Deadlock Characterization – Handling Deadlocks – Deadlock Prevention – Avoidance – Detection – Recovery.	**8 Hours**
MEMORY MANAGEMENT Background – Swapping – Contiguous Memory Allocation – Paging - Segmentation- Virtual Memory Management – Demand Paging – Page Replacement – Thrashing – Working Set - Case Study: Memory Management in the Linux Kernel.	**8 Hours**
I/O MANAGEMENT, DISK SCHEDULING AND FILE MANAGEMENT Evolution of I/O Function – Types of I/O devices – Logical Structure of I/O Functions – I/O Buffering – Disk I/O - Disk Scheduling Algorithms – Disk Cache: Access Methods – Free Space management – Case Study: Ext4 File System in Linux.	**8 Hours**
CASE STUDIES Android OS – Key Features – Use Cases – Android in Mobile Devices – Use in Wearables and Automotive Systems – iOS – Key Features – Use Cases – iOS in Mobile Devices – Use in Wearables and Integration with other Products.	**5 Hours**

Signature of the BOS Chairman

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources
Textbooks
1.Abraham Silberschatz, Peter B. Galvin and Greg Gagne," Operating System Concepts", 10th Edition, John Wiley & Sons, Inc., 2018.
Reference books/ Web Links
1.P.C.Bhatt, "An Introduction to Operating Systems – Concepts and Practice", 4th Edition, Prentice Hall of India., 2013. 2.William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Prentice Hall of India, 2018. 3.D.M.Dhamdhere," Operating Systems: A Concept based Approach", 3rd Edition, Tata McGraw Hill, 2017.
Online Resources
1. https://archive.nptel.ac.in/courses/106/105/106105214/

Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. P. Parameswari, Dept. of Computer Applications	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAT505	CLOUD COMPUTING	L	T	P	J	C
		3	0	0	0	3
PC		SDG	8, 9, 12			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Understand core concepts, service models (SaaS, PaaS, IaaS), and deployment types (public, private, hybrid).
2	Understand virtualization techniques, hypervisors, and their practical applications.
3	Design scalable cloud applications with auto-scaling, load balancing, and database management.
4	Implement cloud security measures, including encryption, firewalls, and identity management.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Apply the fundamentals of cloud computing and deployment models to real-world scenarios.	Ap
CO 2	Analyze cloud service models and explore the basics of virtualization.	An
CO 3	Evaluate hypervisor technologies and cloud scalability solutions.	E
CO 4	Analyze cloud storage solutions and foundational cloud security principles.	An
CO 5	Apply monitoring, encryption, and access management strategies in cloud environments.	Ap

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2				2	
2	2	3		3				
3	2	2						3
4	2			2				2
5		2	2					

Course Content

INTRODUCTION TO CLOUD COMPUTING Introduction to Cloud Computing - Evolution of Cloud Computing – Cloud Characteristics - Elasticity in Cloud - On-demand Provisioning – NIST Cloud Computing Reference Architecture – Architectural Design Challenges.	**8 Hours**
CLOUD COMPUTING: SERVICE AND DEPLOYMENT MODEL Cloud Service Models: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Service Providers, Challenges and Risks in Cloud Adoption. Cloud Deployment Model: Public Clouds – Private Clouds – Community Clouds – Hybrid Clouds – Advantages of Cloud Computing.	**8 Hours**
VIRTUALIZATION Virtualization: Definition – Benefits of Virtualization – Types of Virtualizations – Hypervisors-based: Paravirtualization – Full Virtualization – Virtual Machine Monitor – Hypervisors: Xen, KVM, VMWare, Virtual Box and Hyper-V - Pros and Cons of Virtualization.	**9 Hours**
CLOUD SCALABILITY AND DATA MANAGEMENT Scaling in the Cloud - Auto-Scaling in Cloud - Use of Load Balancers to Enhance Scalability - Elastic Compute Cloud - Cloud Storage - Database in Cloud - Relational DBMS in Cloud - Non-relational DBMS in Cloud – Private and Public Cloud Platforms.	**10 Hours**
SECURITY DESIGN IN THE CLOUD Challenges with Cloud Data - Challenges with Data Security - Security-as-a-Service- Data Confidentiality and Encryption - Data Availability - Data Integrity - Cloud Data Management Interface - Cloud Storage Gateways – Cloud Firewall - Virtual Firewall - Security Monitoring – Identity Management and Access Control**.**	**10 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:45	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:45**

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Learning Resources

Textbooks

1. Sandeep Bhowmik “Cloud Computing”, Cambridge University Press, 2017.
2. Kailash Jayaswal, Jagannath Kallakurch, Donald J. Houde, Deven Shah "Cloud Computing Black Book", Wiley India, 2014.

Reference books/ Web Links

1. Michael J. Kavis “Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" John Wiley & Michel Kavis, 2014.
2. Mehul Mahrishi Kamal Kant Hiran, Ruchi Doshi and Dr.Fagbola Temitayo, “Cloud Computing”, BPB Publications, First Edition, 2019.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGraw-Hill Education, First Edition, 2017.
4. Shailendra Singh, “Cloud Computing”, Oxford University Press, First Edition, 2018.
5. Ted Hunter, Steven Porter and Legorie Rajan P.S, "Building Google Cloud Platform Solutions: Develop Scalable applications from scratch and make them globally available in almost any language", Packt Publishing Limited, 2019.

Online Resources

1. https://explore.skillbuilder.aws/learn/course/external/view/elearning/134/aws-cloud-practitioner-essentials
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843331024379904361 62_shared/overview

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. C. Rajankrupa, Dept. of Computer Applications

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24MAI504	PROBABILITY AND STATISTICS FOR DATA ANALYSIS	L	T	P	J	C
		3	0	2	0	4
BS		SDG	3,8,9,13			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Statistical Tables

Course Objectives:	The purpose of taking this course is to:
1	Equip students with the ability to summarize and interpret data using descriptive statistics, central tendency measures, and graphical tools for effective data visualization.
2	Develop skills in correlation and regression techniques to understand relationships between variables and build predictive models for discrete data.
3	Familiarize students with probability distributions and statistical methods for solving real-world problems involving random variables and hypothesis testing.
4	Enhance students' knowledge of experimental design and variance analysis to assess the effectiveness of statistical techniques and interpret results in data-driven conclusions.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Summarize data using appropriate collection methods, central tendency measures, variation metrics, and graphical tools such as charts and box plots.	Ap
CO 2	Determine the relationship between two variables using correlation techniques (Karl Pearson's and Spearman's) to develop regression models for discrete data to predict outcomes.	Ap
CO 3	Apply the concept of probability distributions for random variables, expectation and normal distribution to solve real-world problems.	Ap
CO 4	Perform hypothesis testing using statistical methods such as large sample tests and chi-square tests to make data-driven conclusions	Ap
CO 5	Analyse the effectiveness of experimental designs, including Completely Randomized Design (CRD), Randomized Block Design (RBD), and Latin Square Design (LSD), through Analysis of Variance (ANOVA).	An
CO 6	Implement statistical methods in R programming to analyze, interpret, and draw insights from data.	Ap

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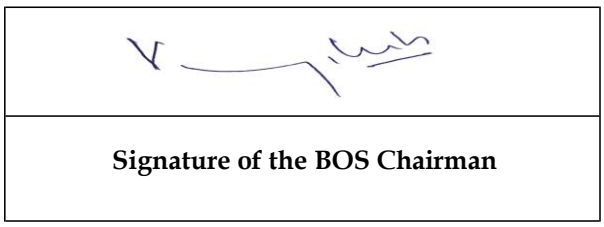
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	2		2				
2	2			2				
3	2	2		2				
4	3			2				
5	2		3	2				
6	2			3				

Course Content

DESCRIPTIVE STATISTICS Collection of Data-Classification-Tabulation-Graphical Representation – Simple Bar Chart – Pie Chart -Measures of Central Tendency: Arithmetic Mean, Median and Mode – Measures of Variation: Range, Quartile Deviation - Standard Deviation and Coefficient of Variation – Five Number Summary – Box Plot Technique. **Practical Component** • Introduction of R, Basic data representation. • Importing data from MS-Excel. • Data presentation methods - Bar Chart, Pie Chart. • Mean, median, mode. • Standard deviation, five number summary, box plot.	**13 Hours** **8 Hours**
CORRELATION AND REGRESSION Correlation (Discrete Data) – Scatter Diagram - Karl Pearson's Correlation Coefficient – Spearman's Rank Correlation – Regression Lines (Discrete Data). **Practical Component** • Scatter diagram, correlation and Regression.	**8 Hours** **4 Hours**
RANDOM VARIABLES Random Variable – Distribution Function – Properties – Probability Mass Function – Probability Density Function – Expectation - Normal Distribution. **Practical Component** • Normal distribution.	**9 Hours** **4 Hours**
TESTING OF HYPOTHESIS Testing of Hypothesis for Large Samples (Single Mean, Difference of Means, Single Proportion, Difference of Proportions) - Chi-Square Test for Independence of Attributes. **Practical Component**	**9 Hours**



Signature of the BOS Chairman

• Large sample test. • Chi square test-independence of attributes.	**8 Hours**
ANALYSIS OF VARIANCE Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD). **Practical Component** • Analysis of Variance (ANOVA).	**6 Hours** **6 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:75

Learning Resources

Textbooks

1. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 12th Edition, 2020.
2. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Duxbury Press, 9th Edition, 2018.
3. Sharma J. K., "Operations Research", Macmillan India Ltd, Delhi, 5th Edition, 2019.
4. Veerarajan. T., "Probability, Statistics and Random Process", Tata McGraw Hill, 4th Edition, 2021.

Reference books/ Web Links

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson and Duxbury, 9th Edition, 2021.
2. Freund, J.E., "Mathematical Statistics", Prentice Hall of India, 7th Edition, 2017.
3. Gupta S.C. and Kapur J.N., "Fundamentals of Mathematical Statistics", 11th Edition, 2019, Sultan & Chand, Publishers, New Delhi.
4. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, 2019.
5. Johnson, R. A., "Miller & Freund's Probability and Statistics for Engineers", 8th Edition, Pearson Education, 2017.
6. Spiegel, M.R. and Stephens, L.J., "Schaum's Outlines: Statistics", Tata McGraw-Hill, 5th Edition, 2020.

Online Resources

1. NPTEL – Probability and Statistics - https://nptel.ac.in/courses/111105090
2. Coursera – Data Analysis with R - https://www.coursera.org/learn/data-analysis-r
3. edX – Introduction to Probability - https://www.edx.org/course/introduction-to-probability
4. Stack Overflow – R Programming - https://stackoverflow.com/questions/tagged/r

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
1. Mr. Ramesh V.S., STEPS Knowledge Services Private Limited, Coimbatore. 2. Mr.Jayakumar Venkatesan, Valles Marineris International Private Limited- Chennai. 3. Mr. Imran Khan, GE Transportation Company, Bangalore.	1. Dr.T.Govindan, Government College of Engineering, Srirangam, Trichy. 2. Dr.C.Porkodi, PSG College of Technology, Coimbatore. 3 Dr.P.Paramanathan, Amrita Vishwa Vidyapeetham, Coimbatore.		1. Dr. Vijeta Iyer, Mathematics 2. Dr. K.Meena, Mathematics
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24HST506	PROFESSIONAL COMMUNICATION STRATEGIES	L	T	P	J	C
		2	0	0	0	2
HS		SDG	4,8			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Demonstrate mastery in using digital tools and software to produce well-structured and effective business documents, aligned with industry standards.
2	Communicate ideas clearly and effectively in written and verbal formats, tailoring messages to fit diverse professional settings, audiences, and cultural contexts.
3	Establish and maintain a professional digital presence on networking platforms such as LinkedIn, portfolios, and personal websites.
4	Exhibit thorough preparation for professional interactions such as meetings, presentations, and interviews by researching relevant topics and aligning personal goals with career opportunities.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Show expertise in creating, revising, and organizing various types of professional documents.	Ap
CO 2	Communicate clearly and effectively in both written and verbal forms across different professional settings, adjusting to diverse audiences and cultural environments.	An
CO 3	Establish and maintain a professional presence online, utilizing digital platforms to enhance networking and career progression.	U
CO 4	Demonstrate thorough preparation and active engagement in professional interactions, aligning personal objectives with career opportunities and overcoming communication challenges.	Ap

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1		1	2		3			3
2		2	2		3		3	3
3		2	2		3		2	3
4		2	2		3		3	3

Course Content

TECHNICAL CORRESPONDENCE Proof Reading (Subject – Verb Agreement - Articles and Preposition - Use of Conjunctions) Paragraph Writing Techniques - Transcoding Graphical Representations - Writing Technical Instructions– Framing Prompts for AI Tools.	**6 Hours**
TECHNICAL READING Reading Strategies for Technical Texts – Subskills - Reading & Summarizing -Reading Comprehension Exercises (Task Types from International Language Exams).	**6 Hours**
BUSINESS CORRESPONDENCE Email Writing (Email Etiquette, Email Structure and Tone, Crafting Clear Subject Lines and Messages, Responding to Emails Professionally) - Formal Letters (Structure and Format, Tone and Language in Business Correspondence) –Drafting Meeting Agenda and Minutes.	**6 Hours**
GROUP DYNAMICS AND LEADERSHIP SKILLS Group Discussion Types of GD – Key Skills for Effective Group Discussions -Roles and Responsibilities - Overcoming Communication Barriers – Leadership Skills - Role of Communication in Leadership - Developing Emotional Intelligence (Self-Regulation, Empathy, Social Skills) – Decision Making and Problem Solving.	**6 Hours**
GOAL SETTING & INTERVIEW SKILLS Types of Goals: Short-Term, Long-Term, Personal, and Professional – SMART Goals - SWOT Analysis – Aligning Personal Goals with Organizational Objectives - Developing a Comprehensive Goal Setting Plan - Job application and Digital Profile - Types of Interviews – Preparing for interview – Answering Common Interview Questions - Handling Difficult Interview Scenarios -Mock Interview.	**6 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:30**

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Learning Resources

Textbooks

-

Reference books/ Web Links

1. Mahesh Kumar, Dr.Soma. “Soft Skills: Enhancing Personal and Professional Success”, McGraw Hill, 2023.
2. Maxwell, John C.,” Developing the Leader within You”, HarperCollins, 2018.
3. Dr. K.Alex, “Soft Skills Know Yourself & Know The World”, Generic, 2011.
4. Burnard, Philip. ,”Interpersonal Skills Training”, Viva Books Private Limited, Feb 2011.

Online Resources

1. https://www.glassdoor.co.in/Interview/index.htm
2. https://www.coursera.org/learn/successful-interviewing
3. https://www.mindtools.com/a5ykiuq/personal-goal-setting
4. https://www.exed.hbs.edu/senior-executive-leadership-program-

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr.Vijayan Ramanathan , Project Manager, Toppan Merrill. Technologies, Coimbatore.	Dr. Aninditha Sahoo, IIT, Madras Dr.P.R. Sujatha Priyadharshini, Anna University Chennai Dr. E. Justin Ruben, CIT, Coimbatore.	Dr. Arokia Lawrence Vijay Dr. A S Mythili

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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SEMESTER II

Signature of the BOS Chairman

24CAT506	CYBER SECURITY	L	T	P	J	C
		3	0	0	0	3
PC		SDG	4,9,16			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Understand fundamental security concepts and principles to recognize the importance of protecting information and systems from various threats.
2	Apply cryptographic methods to enhance data confidentiality and integrity, ensuring secure communication across networks.
3	Analyze security vulnerabilities and risks in computer systems and applications to identify potential weaknesses and develop mitigation strategies.
4	Evaluate security solutions and practices by testing and assessing systems for effectiveness in preventing and responding to cyber threats.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the fundamental security goals, the need for security, and various security approaches.	U
CO 2	Apply symmetric and asymmetric cryptography techniques to secure data.	Ap
CO 3	Analyze penetration testing methodologies and tools to identify potential vulnerabilities in systems.	An
CO 4	Evaluate the effectiveness of various methods for exploiting and securing application vulnerabilities, and insecure coding practices.	E
CO 5	Apply digital forensic techniques and incident response strategies to manage and investigate cyber incidents effectively.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2				2	
2	2	3		3				
3	2			3				
4		2		2				2
5	2		2					3

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Course Content	
INTRODUCTION TO THE CONCEPTS OF SECURITY Security Goals - The Need for Security – Security Approaches -Principles of Security – Attacks - Types of attacks - Sniffing and Spoofing: Packet sniffing - Packet spoofing – Phishing - Pharming.	**8 Hours**
CRYPTOGRAPHY TECHNIQUES Introduction - Plain Text and Cipher Text - Substitution Techniques - Transposition Techniques - Encryption and Decryption - Symmetric and Asymmetric Key Cryptography - Data Encryption Standard (DES) - The RSA Algorithm.	**8 Hours**
PENETRATION TESTING Benefits of Penetration Testing - Attacking and Exploiting - Information Gathering: Open-Source Intelligence Gathering - Port Scanning. Ping Sweeps - Vulnerability Scanning: Nmap Version Scan to Potential Vulnerability - Web Application Scanning- Penetration Testing Tools: Nikto, OpenVAS, Nessus and Nmap.	**10 Hours**
EXPLOITING APPLICATION VULNERABILITIES Exploiting Injection Vulnerabilities: Input Validation - Web Application Firewalls - SQL Injection Attacks - Code Injection Attacks - Exploiting Authentication Vulnerabilities: Password Authentication - Session Attacks - Kerberos Exploits - Exploiting Web Application Vulnerabilities: Cross-Site Scripting (XSS) - Unsecure Coding Practices.	**10 Hours**
DIGITAL FORENSICS Introduction - Forensic Science - Digital Forensics - Fundamentals of Digital Forensics - Uses of Digital Forensics - The Digital Forensics Process - Understanding Incident Response - Managing Cyber Incidents.	**9 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Textbooks

1. Mike Chapple David Seidl, "CompTIA PenTest+ Study Guide" Wiley, 2019.
2. Dafydd Stuttard, Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", John Wiley, 2011.

Reference books/ Web Links

1. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", William Pollock, 2014.
2. Ric Messier, “CEH v12 Certified Ethical Hacker Study Guide”, John Wiley & Sons, 2023.
3. John Sammons, “The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Elsevier Inc, 2015.
4. Gerard Johansen “Digital Forensics and Incident Response”, Packt Publishing, 2017.
5. Atul Kahate “Cryptography and Network Security”, McGraw Hill Education (India) Private Limited, 2013.
6. Behrouz A. Forouzan, “Introduction to Cryptography and Network Security”, McGraw-Hill, Inc., 2015.

Online Resources

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094417601454080189 3_shared/overview
2. https://www.mygreatlearning.com/blog/introduction-to-penetration-testing/
3. https://www.mygreatlearning.com/academy/learn-for-free/courses/cyber-security-threats

Signature of the BOS Chairman

Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. C. Rajankrupa, Dept. of Computer Applications	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAI507	AUTOMATION AND ARTIFICIAL INTELLIGENCE	L	T	P	J	C
		2	0	2	0	3
PC		SDG	4,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Understand the principles, strategies, and components of automation systems and their applications in production.
2	Introduce the role of Industry 4.0 and explore the integration of Robotic Process Automation (RPA) with AI technologies.
3	Gain knowledge of artificial intelligence concepts, including intelligent agents and AI programming techniques.
4	Explore machine learning methods and their applications in intelligent automation across various industries.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Apply the principles and strategies of automation to identify and solve automation problems in production systems.	Ap
CO 2	Analyze the role of intelligent agents in AI and compare different types of agents in various environments.	An
CO 3	Evaluate the effectiveness of various machine learning algorithms in solving specific problems by examining their application and outcomes.	E
CO 4	Examine criteria-based solutions by applying intelligent automation techniques in industries like automotive, healthcare, and insurance.	An
CO 5	Apply intelligent automation technologies in various industrial scenarios and recommend future directions for AI integration.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3		2	3		2		
2	3	2						
3	3	3	3					
4			3	2			2	
5			3					2

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Course Content	
INTRODUCTION TO AUTOMATION Introduction to Automation-Automation in Production System-Automation Principles and Strategies-Basic Elements of an Automated System-Advanced Automation Functions-Levels of Automation-Hardware Components for Automation-Sensors and Actuators- Benefits of Automation - Limitations to Automation. Industry 4.0 -Introduction to Robotic Process Automation (RPA) - Benefits of RPA- Overview of Industries Best-Suited for RPA- Advancements in RPA and its Integration with AI Components of RPA- RPA Platforms-About UI Path- The Future of Automation. **Practical Component** • Study on UI path Tool • Recording Modes • Notepad/Word Automation • Screen Scrapping Techniques to extract text from Images/Web/Document	**7 Hours** **10 Hours**
ARTIFICIAL INTELLIGENCE Introduction to Artificial Intelligence -Intelligent Agents: Agents and Environment- Reactive Agent- Deliberative- Goal Driven- Utility Driven and Learning Agents - Artificial Intelligence Programming Techniques and Applications.	**9 Hours**
MACHINE LEARNING Forms of Learning -Supervised Learning - Unsupervised Learning - Artificial Neural Networks- Non-parametric Models - Support Vector Machines -Statistical Learning - Learning with Complete Data - Learning with Hidden Variables- Introduction to Expectation Maximization Algorithm – Overview of Reinforcement Learning. **Practical Component** • Implement various pre-processing techniques in the dataset. • Split the dataset into Training and Testing data. Fit the data into the model and calculate the performance measures using Decision Tree. • Implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets. • Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. • Implement support vector machine for the given data set. • Implement the K-Means algorithm for the given data set. Evaluate the performance using various K values.	**9 Hours** **20 Hours**
APPLICATIONS OF INTELLIGENT AUTOMATION Applications of Intelligent Automation- Automotive- Life Sciences- Healthcare- Insurance - AI Applications in Industry - Automation using Natural Language Processing, Computer Vision, Speech Recognition-The Future of Intelligent Automation.	**5 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

Signature of the BOS Chairman

Learning Resources

Textbooks

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, 4th Edition, 2020.
2. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, (electronic): 978-1-4842-5729-6", A press,2020.

Reference books/ Web Links

1. M.P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 5th Edition, Pearson Education, 2009.
2. Alok Mani Tripathi, “Learning Robotic Process Automation”, Packt Publishing Release Date: March 2018.

Online Resources

1. https://www.coursera.org/specializations/roboticprocessautomation
2. https://www.coursera.org/professional-certificates/google-it-automation

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. P. Parameswari, Dept. of Computer Applications

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAI508	FULL STACK APPLICATION DEVELOPMENT	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,8,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Learn front-end technologies (HTML, CSS, JavaScript, Bootstrap) and explore web development stacks like MERN, MEAN, and LAMP.
2	Develop routing, middleware, authentication, and REST APIs using the Express framework.
3	Master Node.js for building server-side applications, managing asynchronous I/O, and using modules.
4	Integrate MongoDB, design schemas, and deploy full-stack applications with Node.js.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Apply the basics of HTML, CSS, JavaScript, and Git to create and manage web projects using version control.	Ap
CO 2	Analyse the concepts of Node.js to develop and manage server-side JavaScript applications.	An
CO 3	Distinguish the principles of asynchronous I/O and callbacks to effectively handle Node.js events and errors.	An
CO 4	Evaluate the use of Express framework to implement robust back-end web applications with middleware and routing.	E
CO 5	Design MongoDB schemas and integrate them with Node.js applications to ensure data management and deployment.	C

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3							
2					2			
3		3						2
4				2				
5			3			2		

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Course Content	
INTRODUCTION TO FULL STACK DEVELOPMENT & VERSION CONTROL Overview of HTML, CSS, JavaScript, and Bootstrap. Web Development Stack - Full Stack – Introduction – Types: MERN, MEAN, MEVN, LAMP, Ruby on Rails, Django, .NET, JAMSTACK - Version Control – Need - Popular version control tools like Git - Create a GitHub Account - Use the GitHub Web Interface to Create a Repository - Add a File to Git and Commit the Changes – Git Commands. **Practical Component** • Create your own Node.js module and import and use modules in your web server application.	**9 Hours** **3 Hours**
INTRODUCTION TO NODE.JS Introduction to Node.js - Server-Side JavaScript and Node.js - Creating a Web Server with Node.js - Working with Node.js Modules - Overview of Node Package Manager. **Practical Component** • Develop asynchronous functions with callbacks, error handling, and control flow using callbacks.	**9 Hours** **3 Hours**
SERVER-SIDE JAVASCRIPT Asynchronous I/O with Callback Programming - Creating Callback Functions - Using Anonymous Callback Functions in Node.js - Issues with Callbacks - Working with JSON – Handling Errors and Debugging Node.js Applications. **Practical Component** • Demonstrate JSON file data read and write using Node.js. • Create a RESTful API to serve JSON data. • Demonstrate RESTful endpoints using Express and HTTP methods to handle GET, POST, PUT, and DELETE requests.	**9 Hours** **9 Hours**
EXPRESS WEB APPLICATION FRAMEWORK Extending Node.js - Working with Third Party Node.js Extensions - Introduction to Web Frameworks - Express Web Application Framework - Working with Back-end JavaScript Frameworks and Express - Routing, Middleware, and Templating - Authentication in Node JS - Middleware & Routers - HTTP Methods and Rest APIs. **Practical Component** • Integrate a template engine (e.g., EJS or Pug) with Express and render dynamic HTML views using templates. • Implement user authentication in your Express application. • Explore and integrate third-party Node.js extensions into your Express app. • Create a multi-page web application with authentication, routing, and RESTful APIs.	**9 Hours** **12 Hours**
MONGODB AND DEPLOYMENT OF NODE.JS APPLICATIONS NoSQL databases and MongoDB - Setting up a MongoDB Development Environment - Building MongoDB Schema and Models with Mongoose – Connecting Node.js Application with MongoDB – Testing and Deploying Node.js Applications with Server Configurations. **Practical Component** • Create a simple Employee Management Application with MongoDB and Node.js.	**9 Hours** **3 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:75

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Learning Resources

Textbooks

1. Laura Lemay, Rafe Colburn and Jennifer Kyrnin, ""Mastering HTML, CSS & JavaScript Web Publishing", BPB Publications, 2016.
2. David Herron," Node.js Web Development: Server-side Web Development", Packt Publishing Limited, 5th Edition, 2020.
3. Alex Young, Bradley Meck, Mike Cantelon, Tim Oxley, Marc Harter, T.J. Holowaychuk, and Nathan Rajlich, "Node.js in Action" Manning, 2nd Edition, 2017.

Reference books

1. Luciano Mammino and Mario Casciaro,"Node.js Design Patterns", Packt Publishing Limited,3rd Edition, 2022.
2. Mithun Satheesh, Bruno Joseph D'mello and Jason Krol "Web Development with MongoDB and Node JS", Packt Publishing Limited; 2nd edition, 2015.
3. Ethan Brown ,"Web Development with Node and Express" , O'Reilly Media, Inc. 2nd Edition, 2019.

Online Resources

1. https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javacript?specialization=ibm-full-stack-cloud
2. https://www.coursera.org/learn/getting-started-with-git-and-github?specialization=ibm-full-stack-cloud-developer
3. https://www.coursera.org/learn/developing-backend-apps-with-nodejs-and-express?specialization=ibm-full-stack-cloud-developer
4. https://www.coursera.org/learn/introduction-to-mongodb
5. https://www.coursera.org/projects/showcase-build-a-crud-nodejs-and-mongodb-employee-management-web-app

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. M. Manikantan, Dept. of Computer Applications

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAI509	DATA ANALYSIS AND VISUALIZATION	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,8,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Introduce the core concepts and significance of Exploratory Data Analysis (EDA) to enhance students' ability to interpret and make sense of complex datasets.
2	Equip students with practical skills to apply data wrangling and transformation techniques for preparing datasets for analysis and visualization.
3	Develop proficiency in utilizing advanced visualization tools such as Matplotlib and Seaborn to communicate data-driven insights effectively.
4	Encourage analytical thinking by examining relationships and patterns within datasets through univariate, bivariate, and multivariate analysis techniques.
5	Guide students in evaluating various data analysis and visualization strategies to address complex data challenges and provide actionable insights

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand key data analysis and visualization techniques to effectively interpret and communicate insights from complex datasets	U
CO 2	Apply various tools and methods for data wrangling and transformation to prepare datasets for detailed analysis and visualization.	Ap
CO 3	Apply advanced visualization tools to present data insights and support informed decision making across various contexts.	Ap
CO 4	Analyze relationships and patterns in data using diverse analytical methods to draw meaningful conclusions and support strategic decisions.	An
CO 5	Evaluate different data analysis and visualization strategies to address complex data challenges and generate actionable insights.	An

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3	3					
2	3	3						
3			2	2				
4	3	3						
5			2	2				

Course Content

EXPLORATORY DATA ANALYSIS FUNDAMENTALS Overview – Significance of Exploratory Data Analysis (EDA) – Making Sense of Data – Comparing EDA with Classical and Bayesian Analysis – Software tools for EDA - Visual Aids for EDA- Data Transformation Techniques-Merging Database, Reshaping and Pivoting, Transformation Techniques - Grouping Datasets - Data Aggregation – Pivot Tables and Cross-tabulations.	**6 Hours**
Practical Component • Experiments on data transformation, merging and reshaping datasets, pivot tables, univariate, bivariate, and multivariate analysis, handling missing values, outliers, and developing dashboards.	**5 Hours**
VISUALIZING USING MATPLOTLIB Importing Matplotlib – Simple Line Plots – Simple Scatter Plots – Visualizing Errors – Density and Contour Plots – Histograms – Legends – Colors – Subplots – Text and Annotation – Customization – Three-dimensional Plotting - Geographic Data with Basemap - Visualization with Seaborn.	**6 Hours**
Practical Component • Experiments online and scatter plots, visualizing errors, density and contour plots, histograms, adding legends, colors, subplots, text, annotations, 3D plotting, and visualizing geographic data with Basemap and Seaborn.	**5 Hours**
DATA WRANGLING AND DATA VISUALIZATION Group By Mechanics-Data Aggregation-General Split-Apply-Combine, Pivot Tables and Cross Tabulation. Time Series Data Analysis: Date and Time Data Types a nd Tools-Time Series Basics, -Date Ranges, Frequencies and Shifting-Time Zone Handling-Periods and Periods Arithmetic-Resampling and Frequency Conversion-Moving Window Functions.	**8 Hours**
Practical Component • Experiments online plots, scatter plots, histograms, subplots, 3D plotting, and visualizing data with Basemap and Seaborn.	**5 Hours**

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DASHBOARD CREATION Metrics for Evaluating Classifier Performance - Holdout Method and Random Sub Sampling - Cross- Validation –ROC Curves - Techniques to Improve Classification Accuracy: Bagging – Boosting –Random Forest. **Practical Component** • Experiments on evaluating classifier performance, cross-validation, ROC curves, and improving classification accuracy using bagging, boosting, and random forest techniques.	**8 Hours** **5 Hours**
UNIVARIATE & BIVARIATE ANALYSIS Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series-Relationships Between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations. **Practical Component** • Experiments on distributions, numerical summaries, scaling, time series smoothing, analysing relationships between variables, scatterplots, and contingency tables.	**9 Hours** **5 Hours**
MULTIVARIATE AND TIME SERIES ANALYSIS Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of Time Series Data (TSA) – Characteristics of TSA – Data Cleaning – Time-based Indexing – Visualizing – Grouping – Resampling. **Practical Component** • Experiments on three-variable contingency tables, time series data analysis, data cleaning, time-based indexing, visualization, grouping, and resampling.	**8 Hours** **5 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:75

Learning Resources

Textbooks

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing Ltd., 2020.

Reference books/ Web Links

1. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016.
2. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

Online Resources

1. https://www.datacamp.com/tutorial/exploratory-data-analysis-python
2. https://www.enjoyalgorithms.com/blog/univariate-bivariate-multivariate-analysis

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. N. Jayakanthan, Dept. of Computer Applications	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAT510	FINANCE, ECONOMICS & MARKETING	L	T	P	J	C
		3	0	0	0	3
HS		SDG	4,8,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	To provide students with a foundational understanding of key financial, economic, and marketing principles required for effective business decision-making.
2	To enhance students' analytical skills in evaluating business environments and market conditions to support strategic planning.
3	To develop the ability to create and implement business strategies that align with organizational goals and customer needs.
4	To foster an integrated approach to applying financial, economic, and marketing knowledge for making informed and strategic business decisions.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand fundamental financial concepts, including financial statement analysis and investment decision-making.	U
CO 2	Analyze economic conditions and market dynamics to inform business strategies.	An
CO 3	Develop and implement marketing plans that align with business objectives and create customer value.	Ap
CO 4	Integrate knowledge from finance, economics, and marketing to make strategic business decisions.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2					3		
2		3	2					
3					2			
4	2	3	3					2

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Course Content

INTRODUCTION TO FINANCIAL MANAGEMENT Overview Of Finance in Business Management. Financial Statements: Income Statement, Balance Sheet, Cash Flow Statement. Financial Ratio Analysis and Interpretation. Basics of Capital Budgeting and Investment Appraisal (NPV, IRR).	**15 Hours**
PRINCIPLES OF ECONOMICS FOR BUSINESS Microeconomic Principles: Supply and Demand, Market Structures. Macroeconomic Indicators: GDP, Inflation, Interest Rates, and their Impact on Business. Economic Policies: Fiscal and Monetary Policies and their Implications for Business. Global Economics: Trade, Exchange Rates, and Economic Integration.	**13 Hours**
MARKETING CONCEPTS AND STRATEGIES The Role of Marketing in Business Strategy. Understanding Consumer Behaviour and Market Segmentation. The Marketing Mix: Product, Price, Place, And Promotion Strategies. Developing a Marketing Plan and Measuring its Effectiveness.	**9 Hours**
INTEGRATED BUSINESS STRATEGY Integrating Finance, Economics, and Marketing for Strategic Decision-Making. Case Studies on Successful Business Strategies that Align Financial, Economic, and Marketing Goals. Strategic Planning: Aligning Financial Management, Economic Analysis, And Marketing to Achieve Business Objectives.	**8 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Textbooks

1. Brigham, E. F. and Ehrhardt, M. C., "Financial Management: Theory & Practice", Cengage Learning, 2016.
2. Mankiw, N.G ,"Principles of Economics*",* Cengage Learning, 2014.
3. Kotler, P. and Keller, K. L., "Marketing Management*",* Pearson Education, 2016.

Reference books/ Web Links

(Selected case studies and journal articles provided by the instructor.)

Online Resources

1. https://www.khanacademy.org/economics-finance-domain/core-finance
2. https://hbr.org/topic/marketing

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Mr. Aman Kumar Dubey, KCT BS

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

SEMESTER III

Signature of the BOS Chairman

24CAT601	SOFTWARE PROJECT MANAGEMENT	L	T	P	J	C
		3	0	0	0	3
PC		SDG	8, 12			

Pre-requisite courses	Nil	Data Book / Code book (If any)	Nil

Course Objectives:	The purpose of taking this course is to:
1	Learn to effectively plan and manage the software development process.
2	Master various techniques for accurately estimating costs during project analysis.
3	Gain a deep understanding of quality assurance concepts to ensure functional and reliable software.
4	Analyze and explain the principles of identifying, assessing, and mitigating risks in software projects.
5	Understand project monitoring and control practices

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Levels (BTL)
CO 1	Understand the critical activities involved in scheduling software applications.	U
CO 2	Learn to implement effective risk management activities and allocate resources efficiently for software projects.	Ap
CO 3	Apply various estimation methods to evaluate the scope and feasibility of software projects.	An
CO 4	Acquire the knowledge necessary to design and construct highly reliable software projects.	Ap
CO 5	Design frameworks, manage costs, and prioritize tasks effectively in project and contract management.	U

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1		2			1	2		
2	3	2			1	2		
3		2			1	2		
4		2			2	2		
5	3	2			2	2		

Signature of the BOS Chairman

Course Content	
SOFTWARE PROJECT MANAGEMENT CONCEPTS Introduction - An Overview of Project Planning-Select Project, Identifying Project scope and objectives, infrastructure. project products and Characteristics. Estimate efforts, Identify activity risks, and allocate resources- Software Quality- Defining software quality, ISO9126, External Standards.	**9 Hours**
SOFTWARE EVALUATION AND COSTING Project Evaluation - Strategic Assessment, Technical Assessment, cost-benefit analysis, Cash flow forecasting, cost-benefit evaluation techniques, Risk Evaluation - Selection of Appropriate Project approach - Choosing technologies, choice of process models, structured methods.	**9 Hours**
SOFTWARE ESTIMATION TECHNIQUES Software Effort Estimation - Problems with over and under estimations, Basis of software Estimation, Software estimation techniques, expert Judgment, Estimating by analogy - Activity Planning - Project schedules, projects and activities, sequencing and scheduling activities.	**9 Hours**
RISK MANAGEMENT AND RESOURCE ALLOCATION Risk Management - Nature of Risk, Managing Risk, Risk Identification and Analysis, Reducing the Risk - Resource Allocation - Scheduling resources, Critical Paths, Cost scheduling – Monitoring and Control.	**9 Hours**
PROJECT MONITORING AND CONTROL Creating Framework cost monitoring, prioritizing monitoring - Managing Contracts – Types of Contracts – Stages in Contract Placement – Organizational Behavior- Selecting the Right Person – Motivation.	**9 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:45	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:45**

Learning Resources

Textbooks:

1. Bob Hughes, Mike Cotterell & Rajib Mall "Software Project Management", McGraw- Hill Publications, 6th Edition 2021.
2. Ian Somerville, "Software Engineering", 10th Edition, Pearson Education, 2021.

References:

1. Robert T. Futrell , "Quality Software Project Management", Pearson Education India, 2022.
2. Gopalaswamy Ramesh, "Managing Global Software Projects. How to Lead Geographically Distributed Teams, Manage Processes and Use Quality Models", McGraw Hill Education, 2021.
3. Richard H.Thayer, "Software Engineering Project Management", 2nd Edition, Wiley, 2022.

Online Educational Resources: -

Assessment (Theory course)

SA I, SA II, Activity and Learning Tasks, MCQ, End Semester Examination (ESE)

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.S.Hameed Ibrahim, Dept. of Computer Applications	
Recommended by BoS on	09.05.2025		
Academic Council Approval	No. 28	**Date**	26.06.2025

Signature of the BOS Chairman

24CAJ602	INTERNSHIP	L	T	P	J	C
		0	0	0	6	2
PW		SDG	8, 9			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	The purpose of taking this course is to:
1	Provide students with hands-on experience by applying their knowledge to real-world projects.
2	Develop professional and technical skills required in the workplace.
3	Prepare for future careers through practical exposure to industry practices.

Course Outcomes	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Levels (BTL)
CO 1	Apply foundational knowledge to identify and solve real-world software problems.	Ap
CO 2	Analyze and define problems to create practical solutions using logical thinking.	An
CO 3	Design, develop, and implement effective software solutions, considering customer needs and applying modern tools and technologies.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2	2			2	2
2	2	3	3					2
3	2	2	3	3	3		1	

Theory Hours: 0	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 06	Total Hours:90

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Assessment (Project)
Presentation, Project Report, Viva-voce Examination

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. V. Geetha, Professor, Dept. of Computer Applications	
Recommended by BoS on	09.05.2025		
Academic Council Approval	28	**Date**	26.06.2025

Signature of the BOS Chairman

SEMESTER IV

Signature of the BOS Chairman

24CYS601	PRINCIPLES OF SUSTAINABILITY AND ENVIRONMENTAL SCIENCE	L	T	P	J	C
		1	0	0	0	1
HS		SDG	6,7,12,13,15			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:

The purpose of taking this course is to:

1	Understand the fundamental concepts of Environmental Science.
2	Analyze the impacts of human activities on the environment, evaluating how these factors contribute to sustainability challenges.
3	Create and propose innovative strategies that integrate environmental science principles to address real-world environmental challenges with sustainability practices.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Understand the fundamental concepts of environmental science and explain their significance.	U
CO 2	Analyze the relationships between human activities and environmental changes to assess impacts on ecosystems and sustainability metrics.	An
CO 3	Apply fundamental sustainability principles to suggest simple, practical solutions for environmental challenges in daily life.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2							2
2	2	3					3	2
3	2	2	3				3	3

Course Content

Foundations of Environmental Science : Introduction - Matter and Energy in Natural systems - Cycling of Matter and Energy - Biogeochemical cycle (Hydrologic Cycle - Carbon Cycle -Nitrogen Cycle) - Biodiversity and Ecosystem - Systems and Feedback Mechanism	**15 Hours**

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Climate and Global Change: Global Change basics - Weather vs. Climate - Natural and Anthropogenic Climate change - Past and Present Climate trends - Ecosystem and extinctions due to climate change. **Energy**: Introduction - Energy Conservation strategies **Water and Agriculture**: Introduction - Limits to Water Availability - Water Trends - Agricultural Consumption and Sustainability - Agricultural Limits - Genetically Modified Organisms and Environmental impacts. **Environmental Policy**: Introduction - Negative Externalities - Environmental impact Assessment and Decision Making - Role of Policy in Addressing Environmental Challenges. **Population and Sustainability:** Introduction - Population Growth - Growth Curves - Demographic Transition - Future Populations - Impact of population growth on sustainability **Measuring Sustainability**: Introduction to Sustainability Metrics - Food Miles – Ecological footprint - Tools for Measuring Sustainability.	

Theory Hours:15	**Tutorial Hours: 0**	**Practical Hours: 0**	**Project Hours: 0**	**Total Hours:15**

Learning Resources

Textbooks:

-

References:

-

Online Educational Resources:

1. https://www.coursera.org/learn/environmental-science
2. https://www.coursera.org/learn/sustainability

Assessment (Theory course)

Activity and Learning Task(s), MCQ.

Course Curated by

Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**
-	-	Dr. U.S. Shoba Professor, Department of Chemistry

Recommended by BoS on	25-04-2025		
Academic Council Approval	No. 28	**Date**	26.06.2025

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24CAJ603	Project Work	L	T	P	J	C
		0	0	0	30	15
PW		SDG	8, 12			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Utilize the knowledge to analyze and solve real-world problems effectively.
2	Equip with the skills needed to select and use modern computational tools and methodologies in the development of innovative software solutions.
3	Develop software products that contribute to solving societal and environmental problems.
4	Prepare students for collaborative work, enhancing their ability to lead and function effectively in multidisciplinary teams.
5	Maintain professional ethics and commit to continuous learning.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Demonstrate the ability to identify real-world problems, understand and define the needs of users and stakeholders for software development.	Ap
CO 2	Evaluate and assess the challenges in managing project scope, time, and resources to suggest strategies to optimize project performance.	An
CO 3	Develop innovative solutions to complex software problems by combining industry practices and new technologies.	C
CO 4	Apply relevant tools and techniques to ensure that the solutions meet customer needs.	Ap
CO 5	Work effectively in multidisciplinary teams, contributing to project success through teamwork and communication.	Ap
CO 6	Understand the professional ethics in software development and the importance of continuous learning to adapt to evolving technologies.	U

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3			2			
2		3	2		3	3	2	
3	3		3	3	2	2		
4	2	2	3	3		2		
5	2		3	2	3	2		
6			2				3	3

Theory Hours: 0	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 30	Total Hours:450

Assessment (Project)
Review, Presentation, Project Report, Viva-voce Examination

Course Curated by			
Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)	
-	-	Dr.V.Geetha, Professor, Dept. of Computer Applications	
Recommended by BoS on	09.05.2025		
Academic Council Approval	28	Date	26.06.2025

Signature of the BOS Chairman

PROFESSIONAL ELECTIVES

Signature of the BOS Chairman

Extended Reality

Signature of the BOS Chairman

24CAC601	3D MODELING AND GAME DESIGN	L	T	P	J	C
		2	0	0	2	3
PE		SDG	9			

Pre-requisite courses	NIL	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the fundamentals of 3D space, object creation, and viewport navigation.
2	Equip students with skills to model and manipulate 3D surfaces and objects.
3	Develop understanding of game object creation using physics-based behaviors and lighting.
4	Implement asset integration with interactivity using particle effects and audio in games.
5	Foster the ability to build simple playable games using navigation and animation systems.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Understand the foundational knowledge of 3D modelling and apply on a real time scenario in creating object and environment.	Ap
CO 2	Design and analyse the usage of Game objects and Assets using Physics and Lights.	An
CO 3	Apply Navigations, Particle systems and audio develop simple games.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2					
2		3	2	2				
3			3	2	2			

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Course Content	
BUILDING BLOCKS 3D space- 3D objects- viewports and cPlane basics- selecting objects- solid object creation- outputting images- Boolean modeling and figured space- object snaps and transforms- Boolean modeling- Clipping plane.	**6 Hours**
OBJECT AND SURFACE MODELING Profile modeling – surface- cPlane- revolve- object modeling- project and pull- curves from objects- trimming surfaces- surface modeling – lofting- surface filleting and blending- surface from edge curves- patch surfaces.	**6 Hours**
GAME OBJECTS AND ASSETS Native Game Objects -Manipulating Game Objects - Components in the Game engine - Fundamentals working concept - Materials - Defining the Role of the Prefab - Textures: UV Mapping and Texturing Techniques - Discovering the Standard Shader.	**6 Hours**
IMPLEMENTATION OF ASSETS WITH PHYSICS AND LIGHTING Creating Hierarchies - Using Empty Game Objects as Pivots -Understanding the Physics System – Rigid body Components - Colliders - Scripting Collision Events - Lighting in Games-Analyzing the Different Lights and Properties.	**6 Hours**
NAVIGATION AND ANIMATIONS Animation in Game Development - Creating Animation in the Editor-Refining Animation- NavMesh - NavMesh Agent - NavMesh Obstacle-Creating the Player Controller Game Object- Particles in Video Games-Analyzing Existing Particle Effects-Audio in Game Development -Audio Effects.	**6 Hours**
Project Component: Projects involving3D modeling using Blender and design simple games with effective audio, light, animation and appropriate understanding of physics in Real time environment.	**30 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	**Hours:0**	**Hours:0**	**Hours:30**	**Hours:60**

Learning Resources
Textbooks:
-
References:
1. Unity Technologies. The Ultimate Guide to Game Development with Unity. Unity Technologies, San Francisco (2023). **2.** Schell, Jesse. The Art of Game Design: A Book of Lenses. CRC Press, Boca Raton (2019). **3.** Buttfield-Addison, Paris, Jon Manning, and Tim Nugent. Unity Game Development Cookbook. O'Reilly Media, Inc., Sebastopol (2019). **4.** Thilakanathan, Danan. 3D Modeling for Beginners: Learn Everything You Need to Know About 3D Modeling! Danan Thilakanathan, (2016).

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Online Educational Resources:
1. https://www.coursera.org/learn/introduction-to-3d-modeling 2. https://www.coursera.org/specializations/game-design-and-development 3. https://www.coursera.org/learn/game-design 4. Control physics with C# in Unity (coursera.org) 5. Create basic behavior with C# in Unity (coursera.org) 6. The Complete Guide to 3D Modelling with Blender | Udemy

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. K. Saranya, AP-II/CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC602	AUGMENTED REALITY AND VIRTUAL REALITY APPLICATION DEVELOPMENT	L	T	P	J	C
		2	0	0	2	3
PE		SDG	9			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the concepts, technologies, and differences between Augmented Reality (AR) and Virtual Reality (VR).
2	Explore the system architecture and components of AR and VR environments.
3	Learn asset management techniques like occlusion, lighting, and positioning in immersive systems.
4	Gain hands-on experience in applying ARCore for real-world scenarios.
5	Integrate spatial audio and user interaction in immersive AR/VR applications for effective UX design.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Attain a foundational understanding and difference of Augmented and Virtual reality technologies.	Ap
CO 2	Develop skills in placing assets, managing scale, addressing occlusion, and implementing realistic lighting in AR and VR projects.	C
CO 3	Apply AR and VR in practical scenarios and conducting AR/VR based visualization case studies for product development.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2					
2		3	2	2				
3			3	2	2			

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Course Content

AUGMENTED AND VIRTUAL REALITY BASICS Introduction to Augmented Reality -MAR Market, Actors, and Value Chain - Application vs. Browser -MAR System Architecture- Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.	**8 Hours**
AR AND VR TECHNOLOGIES Placing and positioning assets - Scale and size of assets - Occlusion -Lighting for increased realism - Solid augmented assets – context awareness - tracking in AR - outside-in tracking - motion tracking - environmental understanding - feature points - plane finding – light estimation - anchors - interface issues and lack of UI metaphors -technical constraints – 3D barriers - computer vision limitations -constraints of occlusion and shading. Levels of Immersion in VR Systems - Sensorimotor Contingency -Sensorimotor Contingency in VR - Introduction to the Three Illusions: Place Illusion (PI), Plausibility Illusion (Psi) - Necessary Conditions for Psi - Break of Presence - Presence, Immersion, PI, and Psi - The Pinocchio Illusion - The Rubber Hand Illusion - Psychological Effects of Embodiment Illusion - Visual-Tactile and Visual-Motor Synchrony.	**8 Hours**
AR CORE Android OS - limitations of low light conditions on AR on mobile -simple surfaces challenge AR – user flow - working with tech limitations - preparing your tools - design draft. surface detection and creating plane - user interaction - placing with anchor points - occlusion between virtual assets - light estimation - virtual light to real light - multiplane detection and spatial mapping - processing needs in mobile AR - breaking immersion - framing as a creative device.	**7 Hours**
VR SYSTEMS AND HARDWARES The Virtual world space-positioning the virtual observer- perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory. Illumination models- Reflection models- Shading algorithms, Radiosity, Hidden Surface Removal- Realism -Stereographic image. VR Hardware- sensor hardware, Head-coupled displays, Acoustic hardware. **Project Component:** To Design and Integration of 3D Spatial audio and sound effects to the objects developed and exploring creative possibilities with AR Core, implement AR/VR navigation system (UX), AR/VR interaction system (UX), Applying AR/VR technologies in real time applications.	**7 Hours** **30 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours: 0	Project Hours:30	Total Hours:60

Learning Resources

References:

1. Linowes, J., & Babilinski, K. Augmented Reality for Developers: Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia. Packt Publishing Ltd., (2017).
2. Braun, Anna, & Rizzo, Raffael. XR Development with Unity: A Beginner's Guide to Creating Virtual, Augmented, and Mixed Reality Experiences Using Unity. (2022).
3. Cybellium Ltd., & Hermans, Kris. Mastering Augmented Reality: A Comprehensive Guide to Learn Augmented Reality. (2023).
4. Peddie, J. Augmented Reality: Where We Will All Live. Springer, (2017).
5. Ong, S. Beginning Windows Mixed Reality Programming. Apress, Berkeley, CA, (2017): DOI: 10.978-1.
6. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality (ACM Books)", (2015).

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Online Educational Resources:
1. https://www.coursera.org/learn/ar |Coursera 2. https://www.coursera.org/professional-certificates/meta-ar-developer |Coursera 3. https://www.coursera.org/specializations/extended-reality-for-everybody|Coursera 4. https://www.coursera.org/specializations/virtual-reality 5. https://www.coursera.org/learn/introduction-virtual-reality 6. https://www.coursera.org/learn/making-virtual-reality-game 7. https://www.coursera.org/learn/3d-models-virtual-reality 8. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.K.Saranya, AP-II/CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08//2024

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24CAE603	ADVANCED METAVERSE TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the evolution and core technologies of Extended Reality (XR) within the metaverse.
2	Explore interoperability, immersive interactions, and connected experiences in the metaverse.
3	Examine various domain-specific applications of the metaverse including education, healthcare, and entertainment.
4	Analyze the technological enablers of the metaverse including AI, Web3, blockchain, and cybersecurity.
5	Design and implement immersive interfaces and interactions using metaverse toolchains and asset creation platforms.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Acquire knowledge to differentiate various Extended reality technologies in Metaverse.	U
CO 2	Apply Metaverse Experiences with depth understanding on devices and interoperability.	Ap
CO 3	Analyze Metaverse in various application domains.	An
CO 4	Develop the Metaverse environment with the integration of other technologies.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2		2				
2		2	3	2				
3		3	2	2				
4			3	2	2			

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Course Content	
THE FOUNDATION OF XR & METAVERSE The Brain Science behind VR - Understanding Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Web XR - Differences & Similarities of VR/AR/MR-XR in Metaverse.	**7 Hours**
EXPERIENCE WITH METAVERSE Metaverse-Experiences in metaverse-Avatars in metaverse-Interoperability in the metaverse-connections and communications-Devices to access the metaverse.	**8 Hours**
APPLICATIONS OF METAVERSE Educational potential in metaverse-Learning in the metaverse-Health and architecture in metaverse-Arts, entertainment, and sports in the metaverse-Building a safe metaverse.	**8 Hours**
TECHNOLOGIES IN METAVERSE Web 3.0-Artificial Intelligence (AI) in Metaverse- Cyber Security aspects / How safe is Metaverse - Blockchain, NFT (non-fungible token) and crypto currency -Metaverse and NFTs - Metaverse Use Cases - Top Metaverse platforms - Current Challenges in Mass adoption of XR - Impact of 5G in XR - Role of Microsoft, Apple and Facebook in Metaverse	**11 Hours**
INTERACTING IN METAVERSE On-premise/Local hosting - Cloud Hosting & Streaming services - Distribution via Application Stores - Understanding UI & UX Design Essentials for AR/VR - Types of Navigation - Types of interaction (Understanding Hand controllers, gesture, gaze and voice controls) - Avatar implementations in VR (Torso/Full body) - AR/VR/Metaverse 3D Assets creation Tools Overview - 3D assets creation for VR/AR (Native polygonal modeling, Converting CAD models, 3D Scanning, Photogrammetry)	**11 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

References:

1. Ball, Matthew. The Metaverse: And How it Will Revolutionize Everything. Liveright Publishing Corporation, New York (2022).
2. Newman, Donn. Metaverse for Beginners: The Ultimate Guide to Understanding and Investing in Web 3.0, NFTs, Crypto Gaming, and Virtual Reality. Independently Published, (2022).
3. Scoble, Robert, and Israel, Shel. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything. Patrick Brewster Press, (2016).

Online Educational Resources:

1. https://www.coursera.org/learn/what-is-the-metaverse| Coursera
2. Metaverse Web 3.0 and DeFi: A Fintech Masterclass| Udemy

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr.K.Saranya, AP-II/CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC604	GAME PROGRAMMING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAI503- Object Oriented Programming	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the core principles of game programming using C# and object-oriented techniques.
2	Provide hands-on experience in scripting game mechanics and user interactions.
3	Familiarize students with user interface programming for games.
4	Train students in applying advanced C# features for robust and optimized gameplay systems.
5	Encourage the integration of real-time logic, AI behavior, and event-driven design to create engaging and interactive games.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Develop a solid understanding of game programming by writing and executing basic scripts, and implementing Object Oriented Programming concepts.	U
CO 2	Implement game mechanics and interactions, including player controls, physics, and scoring systems.	Ap
CO 3	Design and script user-friendly UI elements and menus, handling user input and events effectively, by creating an interactive game interface	An
CO 4	Apply advanced programming techniques, including AI behaviors, serialization, and coroutines, to develop complex gameplay systems	Ap

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2	2					
2		2	3	2				
3		2	2	3				
4			3	2	2			

Course Content

OVERVIEW OF C# PROGRAMMING LANGUAGE Introduction to the Game Editor and C# scripting environment, Setting up editor for C# development , Basic syntax and data types in C# ,Writing and executing simple scripts ,OOPS concepts, Implementing OOP concepts , Design patterns and best practices in C# programming. **Practical Component:** • Basic Script Setup and Syntax • Understanding Unity's Component System	**6 Hours** **4 Hours**
SCRIPTING GAME MECHANICS AND INTERACTIONS Implementing player controls and character movement, Collision detection and physics interactions, Handling user input for game interactions, Scripting game mechanics such as scoring, health and inventory systems, Debugging and optimizing scripts for better performance. **Practical Component:** • Basic Player Movement • Creating and Managing Game Objects • Handling Collisions and Triggers	**6 Hours** **8 Hours**
SCRIPTING UI ELEMENTS AND MENUS Introduction to UI system, Scripting UI elements such as buttons, text fields, and sliders, Creating interactive menus and user interfaces, Handling UI events and user input, Designing and implementing user-friendly UI for games. **Practical Component:** • Understanding and Using Collections	**6 Hours** **4 Hours**
ADVANCED C# PROGRAMMING TECHNIQUES Delegates, events, and lambda expressions in C#, Exception handling and error management, Working with collections and LINQ queries, Serialization and data persistence, Introduction to coroutines and asynchronous programming.	**6 Hours**

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Practical Component: • Scriptable Objects for Data Management.	**4 Hours**
SCRIPTING GAMEPLAY SYSTEMS AND AI Implementing AI behaviours using finite state machines and behaviour trees, Scripting gameplay systems for enemy behaviour, pathfinding, and decision-making, Creating dynamic and interactive game environments, Integrating audio, animations, and visual effects with C# scripts, Testing, debugging, and optimizing gameplay scripts **Practical Component:** • Advanced Player Interaction • Physics and Forces • Final Project: Integrating All Concepts	**6 Hours** **10 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	Hours:0	Hours:0	Hours:30	Hours:60

Learning Resources

References:

1. Joe Hocking ,"Unity in Action: Multiplatform Game Development in C#", Manning Publications 2018.
2. Simon Jackson ,"Mastering Unity 2D Game Development", Packt Publishing ,2014
3. Paris Buttfield-Addison, Jon Manning, and Tim Nugent," Unity Game Development Cookbook: Essentials for Every Game", O'Reilly Media, 2019.
4. Harrison Ferrone," Learning C# by Developing Games with Unity", Packt Publishing, 2018.

Online Educational Resources:

1. https://learn.unity.com/
2. https://community.unity.com/

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr.K.Saranya, AP-II/CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No. 27	**Date**	24/08/2024

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IoT, Edge, UAV

Signature of the BOS Chairman

24CAC605	EMBEDDED SYSTEMS FOR IOT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To understand the architecture and functionalities of embedded systems and PIC microcontrollers.
2	To study embedded communication protocols and the structure and services of Real-Time Operating Systems (RTOS).
3	To comprehend IoT fundamentals, architecture, building blocks, and the role of cloud technologies.
4	To explore and interface various IoT hardware platforms, sensors, actuators, and communication protocols.
5	To design and develop IoT applications using suitable development platforms and cloud-based services.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Identify the internal architecture and programming of an embedded processor.	Ap
CO 2	Utilize the basic architecture of Internet of Things based Devices.	Ap
CO 3	Make use of hardware platforms and AI Enabled Boards for application development.	Ap
CO 4	Choose the software platforms to process the IoT Data.	Ap
CO 5	Build an embedded and IoT Solution for real world scenarios.	E

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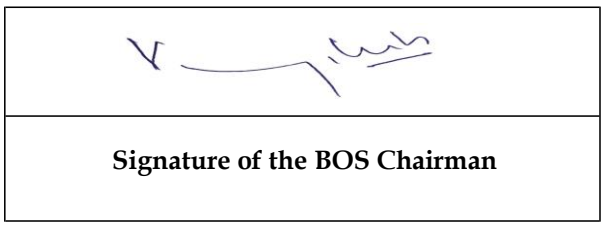
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3		3	2			
2	3		3					
3	3	2	2	2				
4	3		3		3	2		2
5	3	3		2	2	3		

Course Content

EMBEDDED AND MICROCONTROLLER CONCEPTS Introduction to embedded processors-Categories of embedded processors-Architecture-Introduction to PIC microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Embedded Communication Protocols – UART, USART,I2C, SPI, Modbus-Introduction to Real-Time Operating Systems (RTOS)- RTOS Architecture: Layered Architecture of an RTOS -Kernel Components and Their Functions-Real-Time Operating System Services **Practical Component:** • Embedded C Programming and Interfacing with various peripherals	**7 Hours** **6 Hours**
INTERNET OF THINGS Introduction to Internet of Things (IoT), Functional Characteristics, IoT building blocks - Architecture and working - Elements of an IoT ecosystem-IOT Application Development Cycle-Technology drivers, Business drivers, Trends and implications -Recent Trends in the Adoption of IoT, Role of cloud in IoT. IoT Enabling Technologies	**5 Hours**
HARDWARE PLATFORMS FOR IOT Development Boards -Arduino, Raspberry Pi, ESP8266, AI Enabled Boards (Jetson Boards for IoT development), Sensors and actuators -Types-Functions, and applications: Gateways-connectivity options for Short range/Long range Communication- IoT device communication protocols Overview. **Practical Component:** • Integration of Actuators with node MCU (Servo motor/Relay). • Capture Image with node MCU. • Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).	**6 Hours** **8 Hours**



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SOFTWARE DEVELOPMENT FOR IOT IDEs for IoT prototyping- Arduino Programming - Arduino functions- Interfacing with sensors and actuators-Libraries -Input/Output From Pins - Raspberry Pi platform -Environmental - Programming and interfacing with basic hardware components. Open Platforms-Platforms Overview- IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT **Practical Component:** • Make use of cloud platform to log the data.	**6 Hours** **6 Hours**
APPLICATION DEVELOPMENT Development of IoT Applications - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services. IOT Prototyping - Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare. **Practical Component:** • Build a basic home automation system using IoT devices. • Develop an IoT solution for agriculture. • Design an IoT-based smart parking system.	**6 Hours** **10 Hours**

Theory Hours:30	Tutorial Hours:0	Practical Hours: 30	Project Hours:0	Total Hours:60

Learning Resources

Textbooks:

1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, 1119363993,Wiley, First Edition, 2018.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

References:

1. Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2. Raj Kamal, " Internet of Things: Architecture and Design", McGraw Hill.2nd edition June 2022.
3. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing.2014
4. Adrian Mcewen, Hakin Cassimally, "Designing the Internet of Things", First Edition, Wiley, 2014

Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.coursera.org/learn/iot-wireless-cloud-computing
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-_market/

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Mr. M. Sathish, Assistant Professor, CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC606	IOT SYSTEMS DESIGN	L	T	P	J	C
		2	0	0	2	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To understand various IoT architecture models including three-tier, five-tier, mesh, microservices, and serverless architectures.
2	To explore IoT communication protocols across all layers, including MQTT, CoAP, 6LoWPAN, ZigBee, BLE, and LoRa.
3	To learn data ingestion, management, and analytics techniques using edge, fog, and big data technologies in IoT.
4	To analyze integration approaches, IoT middleware, interoperability standards, and API design for scalable IoT systems.
5	To design and implement large-scale IoT solutions considering architectural, scalability, and security challenges through practical case studies.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Choose relevant IoT reference architecture for providing a standardized framework for design and implementation of solutions.	Ap
CO 2	Design and implement IoT systems by selecting appropriate communication protocols to enable seamless data exchange between devices.	Ap
CO 3	Demonstrate proficiency in managing and processing IoT data for real time scenarios.	Ap
CO 4	Articulate the issues and challenges involved in integration of large scale IoT system.	Ap

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3						
2	3	3						
3		3	3		2			
4		3	3		2			

Course Content	
IOT ARCHITECTURE Types of IOT Architecture - Three-Tier IoT Architecture, Five-Tier IoT Architecture, Hierarchical IoT Architecture - Mesh IoT Architecture, Microservices IoT Architecture, Serverless IoT Architecture	**6 Hours**
IOT PROTOCOLS Application Layer Protocols-MQTT , CoAP , HTTP , AMQP . Network Layer Protocol- IPv6, 6LoWPAN, RPL. Data Link Layer Protocols-ZigBee, BLE. Physical Layer Technologies-RFID-LoRa	**6 Hours**
DATA MANAGEMENT AND PROCESSING Data Management -Data Ingestion-Edge and Fog Computing in Large-Scale IoT-Big Data Technologies for IoT-IoT Analytics	**6 Hours**
INTEGRATION AND STANDARDS IoT Network Topologies- Scalability, reliability, and latency requirements-IoT Middleware-Interoperability and Standards -API Design for IoT Integration -Case Studies and Industry Practices	**6 Hours**
INTEGRATING LARGE-SCALE IOT SYSTEMS Overview of Large-Scale IoT Systems-Challenges and Opportunities, Architectural Considerations-Scalable IoT Architectures-Distributed Systems and Microservices- IoT Security-Case Studies- Use cases in Industrial IoT.	**6 Hours**
PROJECT COMPONENT Design and develop prototypes by applying suitable architecture models and protocols in scenarios like cloud-based smart facility management, healthcare, environment monitoring systems, etc.	**30 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	Hours:0	Hours: 0	Hours: 30	Hours:60

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Learning Resources

Textbooks:

1. Cirani, S., Ferrari, G., Picone, M., & Veltri, L., "Internet of Things Architectures, Protocols and Standards", Wiley, 2018.
2. Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D., " From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Springer, 2019.

References:

1. Gravina, R. (Ed.), Palau, C. E. (Ed.), Manso, M. (Ed.), Liotta, A. (Ed.), Fortino, G. (Ed.), "Integration, Interconnection, and Interoperability of IoT Systems (Internet of Things)", Springer, 2018.
2. Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., Henry, J., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press,2017.

Online Educational Resources:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/m2m-iot-interface-design-embedded-systems?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-networking?source=search
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
4. https://www.coursera.org/learn/advanced-iot-systems-and-industrial-applications-course-3
5. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr.V.P.Sumathi, Associate Professor, CSE
Recommended by BoS on	16/08/2024	
Academic Council Approval	No. 27	**Date** 24/08/2024

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24CAC607	3D PRINTING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To understand the fundamentals, history, and diverse technologies of 3D printing, including FDM, SLA, SLS, and emerging methods.
2	To explore the complete 3D printing process chain from design, material selection, slicing, to post-processing and finishing.
3	To gain proficiency in 3D modeling software, parametric design, and preparing digital models for various printing techniques.
4	To develop skills in troubleshooting, calibration, and maintenance of FDM and SLA printers for optimal performance.
5	To investigate advanced 3D printing techniques, materials, and applications across industries such as healthcare, automotive, and education.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Make use of 3D printing technologies and realize the applications.	Ap
CO 2	Identify 3D printing process chain in additive manufacturing.	Ap
CO 3	Develop proficiency in using 3D modelling software.	Ap
CO 4	Identify various issues involves in common 3D printing techniques.	Ap
CO 5	Apply the concepts of advanced 3D printing techniques to develop applications.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3				2			
2		3			2			
3		2			2			
4	3				2			
5	3	2			2			

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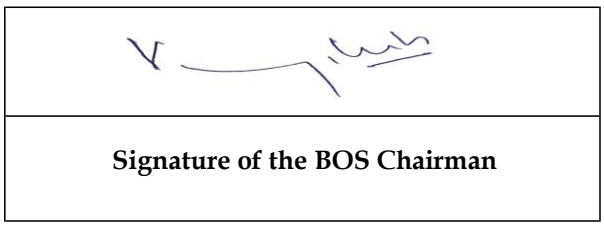
Course Content	
INTRODUCTION TO 3D PRINTING Overview of 3D Printing technology - Historical background and advancements - Applications and real-world examples - Additive manufacturing techniques - Fused Deposition Modeling (FDM) - Stereolithography (SLA) - Digital Light Processing (DLP) - Selective Laser Sintering (SLS) - Direct Metal Laser Sintering (DMLS) - Other Types (MSLA, BJP, EBM, LOM) - Variations of FDM 3D **Practical Component:** • 3D Modeling with Basic Shapes: Introduction to 3D modeling software and creation of basic geometric shapes. • FDM Printing Basics and SLA Comparison: Use an FDM printer for a simple model, then print the same model with an SLA printer for comparison.	**5 Hours** **6 Hours**
3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES Steps in Additive manufacturing - Design for 3D printing - Software in 3D Printing - Materials for 3D Printing - Post-processing and finishing techniques; Introduction to Photopolymerization Processes - Photopolymerization Materials - Reaction Rates - Vector Scan SL - SL Resin Curing Process - SL Scan Patterns - Vector Scan Micro Stereolithography - Mask Projection Photopolymerization Technologies and Processes - Two-Photon SL **Practical Component:** • Calibrating and Optimizing 3D Printers: Learn to calibrate FDM printers, including bed leveling and extruder settings. Also, cover basic SLA printer settings. • Model Correction and Preparation: Identify and correct common 3D model issues, preparing the model for efficient printing.	**7 Hours** **6 Hours**
3D DESIGNING Introduction to 3D modeling software - Creating 3D Models - Designing basic geometric shapes - CAD software and tools - Parametric modeling - Creating complex structures and assemblies; Preparing Models for 3D Printing - Design considerations for 3D printing - Mesh repair and optimization - File formats for 3D printing - Slicing software and its features - Layer height and resolution settings - Support structures; Print bed adhesion techniques – Orientation – Rafts. **Practical Component:** • Orientation and Support Structure Analysis: Experiment with model orientations and support structures for both FDM and SLA printing. • Choosing the Best Printing Method: Analyze a 3D model to determine the most suitable printing method, considering the model's geometry and application.	**6 Hours** **6 Hours**
TROUBLESHOOTING AND CALIBRATION Components of FDM & Stereolithography printers - Identifying and resolving common print issues - Adjusting print settings for optimal results- Materials Handling Issues - Hardware & Software Calibrations. **Practical Component:** • Post-Processing Techniques: Learn post-processing techniques for both FDM (like sanding and painting) and SLA prints (including resin curing and support removal). • Troubleshooting 3D Printers: Identify and resolve common issues in both FDM and SLA printing.	**6 Hours** **6 Hours**
ADVANCED 3D PRINTING TECHNIQUES Multi-Material Unit (MMU) and Multi-Color Printing - Overview of 3D scanning technologies - Point cloud data and mesh generation - Reverse engineering and modification of existing models - High-resolution printing - Large-scale printing - Applications - Industrial applications	**6 Hours**



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- Medical and healthcare applications - Automotive and aerospace industries - Art, Architecture, Fashion & Food - Education and prototyping. **Practical Component:** • Material Analysis and Application: Study different printing materials for FDM and SLA, understanding their properties, strengths, and use cases. • Efficiency and Precision in 3D Printing: Focus on recreating a provided 3D model with precision and optimizing print settings for efficiency within a time limit.	**6 Hours**

Theory Hours:30	Tutorial Hours:0	Practical Hours: 30	Project Hours:0	Total Hours:60

Learning Resources

Textbooks:

9. "Mastering 3D Printing :A Guide to Modeling, Printing and Prototyping" by Joan Horvath, Rich Camerona, published in May 2020.
10. 3D Printing Failures: How to Diagnose and Repair ALL Desktop 3D Printing Issues" by Sean Aranda and David Feeney published in January 2020.

References:

1. "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Ian Gibson, David W Rosen, Brent Stucker published in 2010.
2. "Rapid Prototyping: Principles & Applications" by Chua Chee Kai, Leong Kah Fai published in January 2010.

Online Educational Resources:

1. https://www.coursera.org/specializations/rapid-prototyping-using-3d-printing
2. https://www.coursera.org/learn/3d-printing-applications#modules.
3. https://www.coursera.org/specializations/3d-printing-additive-manufacturing
4. https://www.udemy.com/course/3d-printing-for-beginners/
5. https://www.udemy.com/course/3d-printing-from-start-to-finish/
6. https://www.udemy.com/course/learn-3d-printing/

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. C. Bharathi Priya, Assistant Professor, CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC608	IOT APPLICATION DEVELOPMENT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	To understand the complete IoT application development lifecycle including design, deployment, testing, and optimization.
2	To apply user-centred design principles for creating intuitive and responsive interfaces for IoT device control and management.
3	To explore prototyping and wire-framing techniques for designing multi-device and context-aware IoT interfaces.
4	To analyse testing strategies and tools for ensuring the security, performance, and reliability of IoT systems.
5	To implement effective deployment strategies by configuring edge devices, integrating cloud platforms, and enabling remote monitoring

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply the concept of IoT for application development.	Ap
CO 2	Build context-aware and gestural interfaces for IoT applications.	Ap
CO 3	Construct prototype using wireframes for different device interfaces.	Ap
CO 4	Make use of different testing strategies for IoT applications.	Ap
CO 5	Develop an appropriate deployment architecture for an IoT project.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3		2		3			
2	3		2					
3	3	3			2			
4	3			3				2
5	3		3				3	

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Course Content

INTRODUCTION Overview of IOT Application Development - UI/UX Considerations -Feasibility Study- Architecture and Design- **User Interface for Device Management** - Testing and Quality Assurance- Deployment- Monitoring and Optimization- End-of-Life Planning. **Practical Component:** • Set up a basic IoT ecosystem with microcontrollers and sensors. • Simulate a small-scale smart factory using IoT devices	**5 Hours** **6 Hours**
USER INTERFACE DESIGN User-centered design principles- Device Control Interfaces- Multi-Device Interaction - Responsive Design for Various Screens -Navigation design- Voice and Natural Language Interfaces-Grid systems and layout-Typography in UI design-Color theory and its application-Creating effective user flows- Error Handling and Feedback- Context-Aware Interfaces- Gestural Interfaces. **Practical Component:** • Develop prototypes for Smart City applications such as Smart Street Lights or Smart Waste Management.	**7 Hours** **6 ours**
PROTOTYPING AND WIRE FRAMING Prototyping tools-Types of Prototypes- key elements of wireframes-creating basic wireframes- Device Interface Prototyping- Sensor Data Visualization- Interaction Flows- Mobile and Web Application Wire framing- Voice and Gesture Interaction Prototypes- Edge Computing Integration- Error Handling and Feedback Prototypes- Remote Monitoring Interfaces **Practical Component:** • Design a user interface that adjusts to various screen sizes. • Implement responsive design using CSS and HTML	**6 Hours** **6 Hours**
IOT TESTING Challenges -Unit Testing for IoT Components- Integration Testing for IoT Device -Security Testing for IoT Devices and networks- End-to-End Testing - Automation Framework and Tools -Metrics of Performance testing- Device and Power Management. **Practical Component:** • Use tools like InVision or Marvel to create interactive prototypes for an IoT application	**6 Hours** **6 Hours**
APPLICATION DEPLOYMENT IoT Deployment Strategies and Project Planning-Deployment Considerations- Challenges and Risks -Deployment Architecture-Configure and set up edge devices - Cloud Platform - Connectivity and Communication-Data Handling and Storage-Deployment Testing- Monitoring and Management. **Practical Component:** • Design wireframes for the user interfaces of specific IoT applications (e.g., Smart Home Control). Design a user interface that adjusts to various screen sizes.	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours:0	Practical Hours:30	Project Hours:0	Total Hours:60

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Learning Resources

Textbooks:

1."Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, ISBN: 978-1-119-28568-7, 2016.
2. "Prototyping: A Practitioner's Guide" by Todd Zaki Warfel,2009.

References:

1. Designing in Figma: The Complete Guide to Designing with Reusable Components and Styles in Figma , Eugene Fedorenko, 2020
2. Designing Connected Products: UX for the Consumer Internet of Things" by Claire Rowland, Elizabeth Goodman, Martin Charlier, and Ann Light, 2015
3. "IOT Deployment Handbook: A practical Guide to Implementing Successful IOT Projects" By Richard G. Brown, 2022

Online Educational Resources:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-vg1y/learn/iot?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/interaction-design?source=search
3. https://www.udacity.com/course/ux-design-for-mobile-developers--ud849
4. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/prototyping-design?source=searc
5. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
6. https://www.udemy.com/course/master-the-secrets-of-figma-a-complete-beginners-course/

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Mrs .G. Shobana, Assistant Professor, IT

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC609	ROBOTIC OPERATING SYSTEMS	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAT504-Operating Systems	Data Book / Code book (If any)	NIL

Course Objectives:	
The purpose of taking this course is to:	
1	To understand the fundamental concepts, architecture, and components of ROS including nodes, topics, services, and packages.
2	To utilize ROS tools and environments like Rviz, Rqt, and Gazebo for simulation, visualization, and debugging of robotic systems.
3	To develop ROS nodes and manage communication through topics, messages, services, parameters, and launch files.
4	To implement advanced ROS functionalities such as perception, sensor integration, robot control, and navigation using appropriate libraries and stacks.
5	To interface ROS with hardware by writing drivers, integrating sensors and actuators, and working with real-world robot platforms.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Apply the concepts of ROS to enable the development of robotic system	Ap
CO2	Implement ROS topics and messages for efficient data transfer between nodes.	Ap
CO3	Utilize ROS visualization tools, such as RViz, to analyze and debug ROS applications.	Ap
CO4	Develop ROS perception packages for object detection, recognition, and tracking.	Ap
CO5	Apply ROS drivers for tasks such as sensor data acquisition, robot navigation, and object manipulation	Ap

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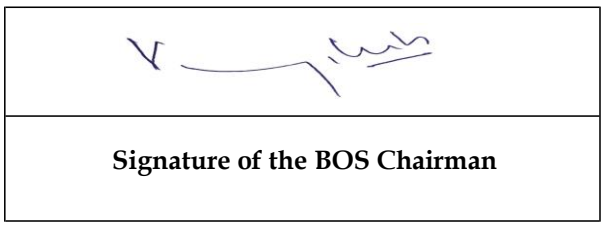
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3				2			
2		3			2			
3					3			
4		3			2			
5	3				2			

Course Content

INTRODUCTION Introduction to ROS-Installation of ROS on different platforms-ROS basic concepts-Components: Nodes, topics, messages, and services- ROS communication architecture-ROS Packages and Ecosystem	**6 Hours**
Practical Component: • Installation and Create a ROS workspace. • Create and run a simple ROS node-Publish and subscribe to ROS topics.	**6 Hours**
ROS TOOLS AND ENVIRONMENT ROS Tools and Environment- command-line tools- ROSIDEs- ROS Integrated Development Environments (IDEs)- graphical tools for visualization and debugging- Rviz, Rqt, and Gazebo-Creating and managing ROS workspaces-Version control with ROS	**6 Hours**
Practical Component: • ROS Tools-Use Rviz for visualization.-Experiment with Rqt tools. • Working with Launch Files:-Create a launch file to start multiple nodes-Pass parameters through launch files.	**6 Hours**
ROS COMMUNICATION ROS nodes and communication - ROS Topics - Publishing and subscribing to topics-Working with ROS topics and messages-ROS services and parameters-ROS launch files for managing multiple nodes-ROS Middleware-ROS Libraries	**6 Hours**
Practical Component: Design a simple robot using URDF • Simulate the robot in Gazebo • ROS Services and Actions	**6 Hours**
ADVANCED ROS TOPICS Perception in ROS- Perception libraries (OpenCV, PCL)- Integration of sensors: Cameras, Lidar, IMU - Basic computer vision techniques in ROS Robot Navigation and Control	**7 Hours**



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- ROS navigation stack-Path planning algorithms-Simulating and executing robot navigation-ROS control stack **Practical Component:** Implement a simple ROS service • Create and use a ROS action server. • Navigation in ROS • Set up the ROS Navigation Stack • Implement basic path planning	**6 Hours**
ROS AND ROBOT DRIVERS ROS and Robot Drivers-Writing drivers to interface hardware with ROS-Interfacing Sensors and Actuators-Connecting sensors and actuators to the ROS ecosystem-Integration with Robot Platforms- Working with popular robot platforms. **Practical Component:** • Computer Vision with ROS, Use OpenCV with ROS for image processing. • Integration with Hardware: Interface with a real-world sensor (e.g., Lidar or IMU) using ROS, Control actuators or motors using ROS commands.	**5 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

Learning Resources

Textbooks:

1. Brian Gerkey, William D, "Programming Robots with ROS: A Practical Introduction to the Robot Operating System", O'Reilly Media; Smart ,1st edition, 2015.
2. Morgan Quigley ,"Robot Operating System (ROS): The Complete Beginner's Guide" Apress; 1st edition , 2018.

References:

1. Lentin Joseph ,"Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy", Apress, 1st edition ,2018.
2. Carol Fairchild, Dr. Thomas L. Harman, ROS Robotics By Example, Packt Publishing Limited, 2016.

Online Educational Resources:

1. https://www.edx.org/learn/robotics/delft-university-of-technology-hello-real-world-with-ros-robot-operating-system
2. https://www.udemy.com/course/ros-essentials/
3. https://www.udemy.com/course/self-driving-and-ros-learn-by-doing-odometry-control/
4. https://www.udemy.com/course/ros-for-beginners/
5. https://www.coursera.org/learn/intro-self-driving-cars?specialization=self-driving-cars

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

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Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
-	-		Dr. N. Jeba, Assistant Professor, CSE
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAE610	SOFTWARE DEFINED VEHICLE	L	T	P	J	C
		3	0	0	0	3
PE		SDG	9			

Pre-requisite courses	24CAC609 – Robotic Operating Systems	Data Book / Code book (If any)	

Course Objectives:

The purpose of taking this course is to:	
1	To understand the fundamentals, evolution, and essential system components of software-defined vehicles.
2	To explore in-vehicle software architectures, including ECUs, bus systems (CAN, LIN, FlexRay), and communication protocols.
3	To learn the software development life cycle and methodologies like Model-Based Development and AUTOSAR for automotive applications.
4	To analyze connected vehicle technologies such as V2V, V2I, V2X, and their underlying communication standards and safety requirements.
5	To study SDV enabling technologies including automation levels, sensor integration, decision-making systems, and OTA updates.

Course Outcomes

After successful completion of this course, the students shall be able to :		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Identify the Software Defined Vehicle concepts and realize the paradigm shift from hardware to software centric vehicle design .	Ap
CO 2	Make use of core principles of SDV architecture, including the separation of hardware and software and the layered software stacks .	Ap
CO 3	Utilize the Model-Based Development (MBD) and AUTOSAR Standard for automotive software development	Ap
CO 4	Apply the key technologies in Self-Driving Vehicles to create a robust and reliable autonomous system.	Ap

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3						
2	3	3						
3			3		2			2
4			3		2			2

Course Content	
INTRODUCTION Overview of software-defined vehicles - Historical perspective and evolution - Essential system basics - Support processes for electronic systems and software development.	**9 Hours**
IN-VEHICLE SOFTWARE ARCHITECTURE Software architectures - ECUs (Electronic Control Units) and their functions - Bus systems – CAN: Concepts, Components, Applications – LIN: Concept, Components - Event Triggered and Time Triggered Protocol - TTCAN - FlexRay - Evaluation of Automotive Software Architectures.	**9 Hours**
AUTOMOTIVE SOFTWARE DEVELOPMENT Software development life cycle - Automotive Software Development - Core process for electronic systems and software engineering - Methods and tools for development - Model-Based Development (MBD) and AUTOSAR Standard - Detailed Design of Automotive Software.	**9 Hours**
CONNECTED VEHICLES Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication - Vehicle-to-Everything (V2X) communication - Wireless Communication Technologies (DSRC, LTE, 5G) - Functional Safety of Automotive Software.	**9 Hours**
SDV ENABLING TECHNOLOGIES Levels of automation - Sensor technologies (LiDAR, RADAR, cameras) – Perception, Localization, Mapping, Decision Making, Planning and Control Systems - Over-the-Air (OTA) Updates - Regulatory Compliance.	**9 Hours**

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Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Textbooks:

References:

1. Jörg Schäuffele , Thomas Zurawka,"Automotive Software Engineering: Principles, Processes, Methods, and Tools", Society of Automotive Engineers, 2016
2. Miroslaw Staron, "Automotive Software Architectures An Introduction", Springer, 2017.
3. Colt Correa, John Simon, Martin Gubow, Samir Bhagwat, "Automotive Ethernet: The Definitive Guide", Intrepid Control Systems, 2nd edition, 2023.
4. Marco Di Natale, Haibo Zeng, Paolo Giusto, Arkadeb Ghosal, "Understanding and Using the Controller Area Network Communication Protocol Theory and Practice", Springer New York, NY,2012.
5. Navet, Nicolas, and Françoise Simonot-Lion, eds. "Automotive embedded systems handbook". CRC press, 2017.
6. Paret, Dominique. "Multiplexed networks for embedded systems: CAN, LIN, flexray, safe-by-wire.", John Wiley & Sons, 2007.

Online Educational Resources:

1. **https://www.coursera.org/learn/intro-self-driving-cars**

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Mrs.V.Senthil Kumar, Assistant Professor, CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No. 27	**Date**	24/08/2024

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Cyber Security

Signature of the BOS Chairman

24CAC611	ETHICAL HACKING AND NETWORK DEFENCE	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4,9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	The purpose of taking this course is to:
1	Introduce the foundational concepts of ethical hacking
2	Enable students to understand and apply information gathering techniques
3	Equip learners with knowledge and skills for system-level hacking
4	Develop the ability to identify and exploit common web application vulnerabilities
5	Expose students to wireless network vulnerabilities and defense mechanisms

Course Outcomes	After successful completion of this course, the students shall be able to	Revised Bloom's Taxonomy Levels (RBT)
CO 1	Illustrate the legal and ethical requirements related to ethical hacking	Ap
CO 2	Interpret the vulnerabilities, mechanisms to identify vulnerabilities, threats, attacks.	Ap
CO 3	Perform penetration & security testing to identify the vulnerabilities in the application.	An
CO 4	Examine the different tools and techniques that ethical hackers employ	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3						2	2
2	2	3		2				
3		2	3	2				
4	3			2				2

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Course Content	
ETHICAL HACKING OVERVIEW & VULNERABILITIES Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking. **Practical Component:** • Identifying and Categorizing Vulnerabilities • Working with Trojans, Backdoors	**6 Hours** **6 Hours**
FOOTPRINTING & PORT SCANNING Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers, tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting enumeration-Introduction, enumerating windows OS & Linux OS **.** **Practical Component:** • Passive Footprinting using WHOIS, nslookup, and Google Hacking • Active Footprinting using Recon-ng and theHarvester • Port Scanning with Nmap	**6 Hours** **6 Hours**
SYSTEM HACKING Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Side-channel Attacks on Cryptographic Hardware: Basic Idea, Current-measurement based Side-channel Attacks. Hardware Trojans: Hardware Trojan Nomenclature and Operating Modes, Countermeasures Such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans**.** **Practical Component:** • Password Cracking and Remote Guessing • Network Sniffing & HTTPS Sniffing • Active and Passive Sniffing	**6 Hours** **6 Hours**
HACKING WEB SERVICES & SESSION HIJACKING Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools. **Practical Component:** • Implement the SQL injection attack. • Cross-Site Scripting (XSS)	**6 Hours** **6 Hours**
HACKING WIRELESS NETWORKS Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks. **Practical Component:** • Denial of Service and Session Hijacking using Tear Drop, DDOS attack. • Wireless and mobile hacking and security	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

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Learning Resources
Textbooks:
-
References:
1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2013 2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2016 3. Rajat Khare, "Network Security and Ethical Hacking", Luniver Press, 2006 4. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, 2011. 5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003. 6. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, "Hardware Security: Design, Threats, and Safeguards", CRC Press, 2015
Online Educational Resources:
1. https://www.coursera.org/learn/ethical-hacking-essentials-ehe

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr N.Suganthi, Prof / CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No. 27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAE612	CYBER ETHICS AND LAWS	L	T	P	J	C
		3	0	0	0	3
PE		SDG	4			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Familiarize students with the foundations of electronic business and legal issues
2	Impart an understanding of cyber ethics and the necessity for cyber regulation
3	Introduce students to the evolution and framework of cyber law
4	Enable learners to comprehend the Information Technology Act, 2000 and its amendments
5	Develop awareness of national and international legislation related to cyber law

Course Outcomes	After successful completion of this course, the students shall be able to	Revised Bloom's Taxonomy Levels (RBT)
CO 1	Demonstrate a comprehensive understanding of electronic business models, including e-commerce, mobile commerce and its legal issues	Ap
CO 2	Interpret Cyber Ethics and its significance in the context of technology and information systems.	Ap
CO 3	Develop a solid foundation in the principles and concepts of cyber laws	Ap
CO 4	Illustrate information Technology act and legislation addressing cybercrime, including laws pertaining to unauthorized access, hacking, identity theft and online fraud solution.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2					2	3	
2		2					3	2
3	3						2	2
4		2				2	3	

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Course Content	
ELECTRONIC BUSINESS AND LEGAL ISSUES Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models-B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI,E-markets, Emerging Trends.	**9 Hours**
CYBER ETHICS The Importance of Cyber Law, Significance of Cyber Ethics, Need for Cyber regulations and Ethics, Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Blockchain Ethics.	**9 Hours**
INTRODUCTION TO CYBER LAW Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Webspace, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	**9 Hours**
INFORMATION TECHNOLOGY ACT Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.	**9 Hours**
CYBER LAW AND RELATED LEGISLATION Patent Law, Trademark Law, Copyright, Software Copyright or Patented, Domain Names and Copyright disputes, Electronic DataBase and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution, Online Dispute Resolution(ODR).	**9 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Textbooks:

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References:

1. Kumar K, “Cyber Laws: Intellectual property & ECommerce, Security”,dominant Publisher, 2011.
2. Christoph Stuckelberger, Pavan Duggal,” Cyber Ethics4.0”, Globethics, 2018.
3. Verma S,K “Legal Dimensions of Cyber Space”, Mittal Raman,Indian Law Institute, New Delhi, 2004.
4. Jonthan Rosenoer, “Cyber Law- The law of Internet”, Springer,2011.
5. S.R.Bhansali, “The Right to Information Act 2005”, Sudhir Naib,OUP India, 2011.
6. Vasu Deva, “Cyber Crimes and Law Enforcement”, Commonwealth Publishers, New Delhi, 2017.

Online Educational Resources:

1. https://www.coursera.org/videos/business-of-cybersecurity-capstone/ OxfpG?query= CYBER+LAWS+AND+ETHICS
2. https://www.coursera.org/learn/business-of-cybersecurity-capstone/
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/-security-principles

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Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr L. Latha Prof/ IT	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No. 27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC613	SECURE SOFTWARE DEVELOPMENT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4,9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	NIL

Course Objectives:	The purpose of taking this course is to:
1	Develop a strong foundation in software security principles, including threats, vulnerabilities, and secure software development life cycle (SDLC).
2	Learn to identify, assess, and mitigate security risks in software applications through risk management techniques and threat modelling.
3	Implement secure design principles, including buffer overflow prevention; secure coding practices, and defense mechanisms against low-level attacks.

Course Outcomes	After successful completion of this course, the students shall be able to :	Revised Bloom's Taxonomy Levels (RBT)
CO 1	Demonstrate various vulnerabilities related to memory attacks.	Ap
CO 2	Apply security principles in software development.	Ap
CO 3	Evaluate the extent of risks.	Ap
CO 4	Apply security principles in the testing phase of software development.	Ap
CO 5	Use tools for securing software.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2		2				
2	2	2	3					
3		2	2	2				
4		2	2	3				
5	2		2	3				

Course Content

NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS Introduction - Software Assurance and Software Security –Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software	**6 Hours**

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– Secure SDLC- Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks. **Practical Component:** • Implement the Buffer Overflow attack	**4 Hours**
SECURE SOFTWARE DESIGN Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating the Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles. **Practical Component:** • Implement the SQL injection attack. • Implement Cross Site Scripting and Prevent XSS.	**7 Hours** **6 Hours**
SECURITY RISK MANAGEMENT Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.	**5 Hours**
SECURITY TESTING Traditional Software Testing – Comparison - Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client-Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing. **Practical Component:** • Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux. • Develop and test the secure test cases	**8 Hours** **10 Hours**
SECURE PROJECT MANAGEMENT Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice. **Practical Component:** • **Penetration test using Kali Linux**	**4 Hours** **10 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours:0	Total Hours:60

Learning Resources

Textbooks:

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References:

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2009.
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011.
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006.
4. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”,Addison-Wesley Professional, 2005.
5. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.

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6. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012.
7. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012.
8. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing, 2012.

Online Educational Resources:

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Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr.K.Mani Bharathi, CSuite Tech Labs	Dr.M.Sangeetha Associate Professor Coimbatore Institute of Technology, Coimbatore		Dr.V.Vanitha Professor/CSE
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC614	NETWORK SECURITY ADMINISTRATION	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4,9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	The purpose of taking this course is to:
1	To introduce the fundamental principles of network security
2	To impart knowledge on cryptographic algorithms and their practical implementation
3	To develop the ability to secure email communications and IP layer data transmission
4	To equip students with hands-on skills for network security administration tasks
5	To enable learners to configure and manage secure network environments

Course Outcomes	After successful completion of this course, the students shall be able to	Revised Bloom's Taxonomy Levels (RBT)
CO 1	Identify types of security attacks, services and mechanisms.	Ap
CO 2	Interpret the implementation of Internetwork security model and its standards	Ap
CO 3	Illustrate Email privacy system and compare Pretty Good Privacy (PGP) and S/MIME .	Ap
CO 4	Interpret the primary components of a Three-Tier Architecture and explain how they work together firewall environment.	Ap
CO 5	Interpret the primary components of a Three-Tier Architecture and explain how they work together firewall environment.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2		2				
2	2	2	2					
3	2		3	2				
4	2		2	3				
5		2	2	3				

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Course Content	
NETWORK SECURITY BASICS Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks. **Practical Component:** • Simulating Interruption, Interception, Modification and Fabrication Attacks • TCP Session Hijacking	**6 Hours** **6 Hours**
NETWORK SECURITY ALGORITHM Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC **Practical Component:** • Implementation of Conventional Encryption Algorithms • Implementation of secure hash algorithm	**6 Hours** **6 Hours**
EMAIL SECURITY Email privacy: Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. **Practical Component:** • IPSec Packet Analysis and Security Association Setup • Simulate IPSec Authentication and Encryption	**6 Hours** **6 Hours**
NETWORK SECURITY MANAGEMENT Deploying Smart Console - Security Management Server - Security Gateway - Configuring Objects in Smart Console-Establishing Secure Internal Communication - Managing Administrator Access - Managing Licenses - Creating a Security Policy -Configuring Order Layers. **Practical Component:** • Configuring objects in smart console - Managing administrator access for an operating system - Elevating Security with Autonomous Threat Prevention	**6 Hours** **6 Hours**
NETWORK SECURITY CONFIGURATION Configuring a Shared Inline Layer - Configuring NAT - Integrating Security with a Unified Policy - Elevating Security with Autonomous -Threat Prevention - Configuring a Locally Managed Site-to-Site VPN - Elevating Traffic View - Monitoring System States - Maintaining the Security Environment. **Practical Component:** • Configuring NAT to use a private IP address- Creating a security policy and integrating it with a unified policy - Monitoring System States and Maintaining the Security Environment	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

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Learning Resources
Textbooks:
-
References:
3. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education 2018. 4. Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech ,"Hack Proofing your network",Syngress, 2002. 5. Bernard Menezes ,"Network Security and Cryptography",CENGAGE Learning, 2010. 6. CharlienKaufman, Radia Perlman and Mike Speciner, "Network Security - Private Communication in a Public World" ,Pearson/PHI ,2002. 7. Stallings, "Cryptography and network Security", Third edition, PHI/Pearson. 8. Whitman, "Principles of Information Security",Cengage Learning, 2006.
Online Educational Resources:
1.https://www.checkpoint.com/mind/secureacademy#

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.A.Roshini, Assistant Professor III,CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC615	DIGITAL FORENSICS	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4,9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Learn the systematic approach to digital investigations, encompassing identification, preservation, analysis, and reporting of digital evidence.
2	Acquire skills to collect, preserve, and analyze digital evidence from various devices and platforms, ensuring the integrity and admissibility of the evidence.
3	Gain hands-on experience with industry-standard forensic tools and software used for data recovery, analysis, and reporting.
4	Develop the ability to document findings clearly and concisely, creating reports suitable for legal proceedings and organizational reviews.

Course Outcomes	After successful completion of this course, the students shall be able to	Revised Bloom's Taxonomy Levels (RBT)
CO 1	Illustrate the digital forensics process and digital evidence acquisition.	Ap
CO 2	Explain file systems and data recovery procedures.	Ap
CO 3	Demonstrate computer, network and mobile forensics with specialized tools.	Ap
CO 4	Analyze malware and report the relevant incident.	Ap
CO 5	Utilize the forensics toolkit for efficient investigation and understand the legal aspects of digital forensics.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3			2			2	
2	2	3		2				
3	2		2	3				
4		2	3					2
5	2					2	3	

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Course Content

OVERVIEW OF DIGITAL FORENSICS Understanding the role of digital forensics in investigations. Legal and Ethical Considerations: Adhering to legal and ethical standards in digital investigations. Digital Forensics Process: Introduction to the forensic investigation process. **Digital Evidence Acquisition:** Types of Digital Evidence: Identifying and classifying digital evidence. Evidence Acquisition Tools: Using tools for acquiring data from different devices. Forensic Imaging: Creating forensic images of storage media **Practical Component:** • Usage of Autopsy tools to Identify and classify the digital evidence	**6 Hours** **6 Hours**
FILE SYSTEMS AND DATA RECOVERY File System Analysis: Understanding file systems and their structures. Deleted File Recovery: Techniques for recovering deleted files. File Carving: Extracting files from unallocated space. **Practical Component:** • Demonstration of the data recovery techniques	**6 Hours** **6 Hours**
COMPUTER, NETWORK AND MOBILE DEVICE FORENSICS Computer Forensics: Investigating computers for evidence- Network Forensics: Analysing network traffic and logs- Memory Forensics: Examining volatile memory for evidence. Mobile Device Investigation: Extracting evidence from smartphones and tablets. App and Cloud Forensics: Investigating applications and cloud-based services. Challenges in Mobile Forensics: Addressing unique challenges in mobile investigations. **Practical Component:** • Demonstration of the process of analysing the network traffic and logs.	**6 Hours** **6 Hours**
MALWARE ANALYSIS Introduction to Malware - Understanding different types of malware- Static and Dynamic Analysis: Analysing malware behaviour and code. Responding to malware incidents- Incident Response and Forensic Tools- Incident Response Planning: Preparing for and responding to security incidents. Introduction to bug bounty – Working of bug bounty - Bug bounty program examples – Setting up bug bounty program. **Practical Component:** • Demonstration of extracting the evidence from mobile phone	**6 Hours** **6 Hours**
AUTOMATED FORENSICS Introduction to popular forensic tools- Automated Forensics: Leveraging automation for efficient investigations-Automated Forensics: Leveraging automation for efficient investigations. Legal Aspects of Digital Forensics: Expert Witness Role: Preparing for and testifying in court- Digital Forensics Laws and Regulations: Understanding legal frameworks - Case Studies: Analysing legal cases involving digital forensics. **Practical Component:** • Analysing the malware behaviour and its code.	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

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Learning Resources

Textbooks:

1. André Årnes, Digital Forensics, Publisher(s): Wiley, July 2017.

References:

1. New Orleans, LA, USA, Digital forensics and cybercrime: 10th International EAI Conference, ICDF2C 2018, September 10-12, 2018.
2. Adam M. Bossler, Kathryn C. Seigfried-Spellar, Thomas J. Holt.,Cybercrime and Digital Forensics : An cybercrime And Digital Forensics : An Introduction, 3rd Edition May 2022.

Online Educational Resources:

1. https://www.coursera.org/learn/digital-forensics-concepts.
2. https://www.open.edu/openlearn/science-maths-technology/digital-forensics/contentsection-0?active-tab=content-tab.
3. https://www.edx.org/learn/computer-forensics/rochester-institute-of-technologycomputer-forensics

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr G.Kanagaraj, AP / CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

Automation and Artificial Intelligence

Signature of the BOS Chairman

24CAC616	DEEP LEARNING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4			

Pre-requisite courses	24CAI507 Automation and Artificial Intelligence	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand and apply fundamental concepts of deep learning, including artificial neural networks (ANNs), activation functions, optimization methods, and regularization techniques.
2	Develop and implement convolutional neural networks (CNNs) for image classification, object detection, and transfer learning using state-of-the-art architectures.
3	Explore sequential modelling using recurrent neural networks (RNNs), long short-term memory (LSTM), and gated recurrent units (GRUs) for applications in natural language processing

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Attain a foundational understanding of Neural Networks and Deep Learning.	Ap
CO2	Develop Convolution Neural Network for complex engineering problems using pretrained models.	Ap
CO3	Realize the significance of the Sequence Models.	An
CO4	Utilize an appropriate unsupervised deep learning approach for addressing sophisticated technology challenges.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3	2	3	3			
2	3	3	3	3	3			
3	3	3	3	3	3			
4	3	3	3	3	3			

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Course Content	
INTRODUCTION Basic Concept of Neurons – Perceptron Algorithm – Activation Functions – Loss Functions - Feed Forward and Backpropagation Networks- Deep Feed-Forward Neural Networks – Gradient Descent for Neural Networks **Practical Component:** • Train Simple Perceptron with Gradient Descent for regression	**8 Hours** **6 Hours**
CONVOLUTION NEURAL NETWORKS Convolution and its variants – Pooling Layers – Down sampling, stride, and padding - Transfer Learning – CNN Architectures: ResNet, AlexNet – Image Classification using Transfer Learning. **Practical Component:** • Implement Backpropagation algorithms • CNN for image classification • Perform object detection with Transfer Learning.	**7 Hours** **8 Hours**
SEQUENCE MODELING Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Bi-directional RNN - Recursive Neural Networks- LSTM and GRU – Attention and the transformer - Applications. **Practical Component:** • Text Classification using LSTM and Bi-directional RNN • Transformer Implementation.	**8 Hours** **6 Hours**
DEEP LEARNING MODELS Autoencoders (AE) – AE Variants - Deep Boltzmann Machine - Deep Belief Networks - Architecture - Greedy Learning – Speech Processing and Recognition using DBN. **Practical Component:** • Implementation of Autoencoders and Variants • Speech Recognition using Deep Belief Networks	**7 Hours** **10 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

Learning Resources

Textbooks:

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

References:

1. Magnus Ekman, "Learning Deep Learning", Addison-Wesley Professional, 2021.
2. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
3. Magnus Ekman, "Learning Deep Learning", Addison-Wesley Professional, 2021.
4. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.
5. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer 2018

Online Educational Resources:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/neural-networks-deep-learning?source=search#modules
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/deep-learning?source=search

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Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. Shalmiya P, AP/AIDS	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC617	COMPUTER VISION	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4			

Pre-requisite courses	24CAI507 Automation and Artificial Intelligence	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the core principles of computer vision, focusing on image formation, representation, and transformation.
2	Impart knowledge on image analysis methods, including feature extraction, segmentation, smoothing, and equalization.
3	Foster analytical skills for comparing and evaluating vision algorithms, such as projection and object recognition techniques.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Apply the fundamentals of computer vision to the formation and transformation of images.	Ap
CO2	Apply feature extraction Techniques in image and segmentation.	Ap
CO3	Ability to perform smoothing and image equalization.	An
CO4	Compare various projection and object recognition methods.	An
CO5	Evaluate performance of computer vision algorithms in various applications.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3	3					
2		3		3				
3							2	2
4	3		2					
5			3				3	

Signature of the BOS Chairman

Course Content

INTRODUCTION Image Processing, Computer Vision - Low-level, Mid-level, High-level, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing	**6 Hours**
Practical Component: • Detect the RGB colour from a webcam • Face and Hand Landmarks Detection	**7 Hours**
FEATURE EXTRACTION AND FEATURE SEGMENTATION Feature Extraction -Edges - Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Image Segmentation -Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation.	**6 Hours**
Practical Component: • Real-Time Edge Detection • Implement Canny Edge Detector • Gun Detection • Real-time object color detection	**8 Hours**
IMAGES, HISTOGRAMS, BINARY VISION Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms - Histogram/Image Equalization - Histogram Comparison - Back-projection - k-means Clustering.	**6 Hours**
Practical Component: • Image Loading, Grayscale Conversion, and Histogram Analysis • Binary Vision and Histogram Back projection • Image Segmentation using K-Means Clustering	**7 Hours**
3D VISION AND MOTION Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion–spline-based motion- optical flow – layered motion.	**6 Hours**
Practical Component: • Depth Estimation and 3D Reconstruction from Stereo Images • Optical Flow and Motion Estimation • Surface Representation and 3D Object Recognition	**8 Hours**
APPLICATIONS Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Virtual Reality and Augmented Reality-Pretrained models- VGG-16-ResNet50.	**6 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	Hours: 0	Hours:30	Hours: 0	Hours:60

Signature of the BOS Chairman

Learning Resources

Textbooks:

1. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education.2 nd Edition ,2015.

References:

1. Joseph Howse , Joe Minichino " Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, Packt Publishing Limited 3rd Edition , 2020.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
3. Sonka M, Hlavac V, Boyle R, Image processing, analysis, and machine vision, Cengage Learning; 2014

Online Educational Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105216/
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/introduction-computer-vision-watson-opencv

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. Shalmiya P, AP/AIDS

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC618	NATURAL LANGUAGE PROCESSING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4			

Pre-requisite courses	24CAI507 Automation and Artificial Intelligence	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the foundational concepts of Natural Language Processing (NLP) and enable students to apply lexical analysis and parsing techniques for effective text pre-processing.
2	Equip students with the knowledge to select and implement suitable statistical and machine learning models for solving real-world NLP problems
3	Develop the ability to critically analyze and compare different NLP algorithms and recommend appropriate solutions based on linguistic and computational requirements.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply lexical and parsing techniques to perform pre-processing steps of NLP	Ap
CO 2	Apply appropriate statistical models for a given natural language application.	Ap
CO 3	Analyze various algorithms that suit any natural language for processing.	An
CO 4	Suggest appropriate pre-processing steps essential for the various applications involving natural language processing.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3							
2	3	2		3			3	
3	2		3	2				
4	2	3						

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Course Content

LEXICAL ANALYSIS AND MORPHOLOGY Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models - Hidden Markov Models. **Practical Component:** • Recognize word forms using regex and simulate with automata • Perform morphological analysis • Implementation of POS tagger	**8 Hours** **5 Hours**
SPEECH PROCESSING Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule based-Concatenative based approach. **Practical Component:** • Annotate speech segments by articulatory features • Build and compare Text to Speech systems. • Develop a basic speech recogniser.	**6 Hours** **6 Hours**
PARSING Parsing Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields. **Practical Component:** • Implementing and Analyzing the CYK Parser • Named Entity Recognition using Conditional Random Fields • Dependency Parsing and Ambiguity Resolution	**6 Hours** **6 Hours**
LEXICAL KNOWLEDGE NETWORKS Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilingualism - Metaphors - Co-reference and Anaphora Resolution. **Practical Component:** • Investigate word senses and implement disambiguation techniques. • Identify and resolve co-referring expressions in text.	**6 Hours** **6 Hours**
APPLICATIONS Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR) **Practical Component:** • Classify sentiments • Retrieve relevant documents across languages using multilingual representations • Develop a Chatbot	**4 Hours** **7 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

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Learning Resources

Textbooks:

1. Jurafsky Daniel, Martin James, “Speech and Language Processing”, Second Edition, Tenth Impression, Pearson Education, 2018.

References:

1. Christopher Manning, Schutze Heinrich, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana “ Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems”, Oreilly Publications, 2020.
3. Steven Bird , Ewan Klein , Edward Loper, “Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit”. Oreilly Publications, 2007.

Online Educational Resources:

1. https://www.udemy.com/course/nlp-natural-language-processing-with-python
2. https://www.coursera.org/specializations/natural-language-processing
3. https://www.edx.org/learn/natural-language-processing
4. https://www.simplilearn.com/natural-language-processing-training-course
5. https://www.mygreatlearning.com/nlp/free-courses

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr .Rajini, ASP/CSE

Recommended by BoS on	16/082024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC619	GENERATIVE AI	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4			

Pre-requisite courses	24CAI507 Automation and Artificial Intelligence	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce students to the foundational principles of Generative AI.
2	Enable students to apply advanced neural network models.
3	Develop the ability to analyze real-world use cases of Generative AI.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Acquire insights into the key technological trends driving generative AI models	Ap
CO2	Acquire the ability to apply effective prompt engineering techniques to enhance the performance and control the behavior of generative AI models	An
CO3	Build, train and apply generative models and develop familiarity with platforms	An
CO4	Ability to comprehend ethical issues and limitations of generative AI models	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	2						2
2		3	3	3	2	3	3	2
3			3	3		3	3	2
4							3	2

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Course Content

INTRODUCTION TO GENERATIVE AI Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases	**5 Hours**
Practical Component: • Text and Image Generation using Generative AI • Code Generation	**6 Hours**
PROMPT ENGINEERING TECHNIQUES AND APPROACHES Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts	**6 Hours**

Practical Component:
• Experimenting with Prompts
• Approaches in Prompt Engineering
  o Chain-of-Thought Approach
  o Interview Pattern Approach
  o Tree-of-Thought Approach
	8 Hours

MODELS FOR GENERATIVE AI Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Autoencoders (VAEs) – Transformer–based Models - Diffusion models- Applications.	**7 Hours**
Practical Component: • Sequential Data Processing using RNNs and LSTM • Image Generation using GANs and VAEs	**8 Hours**
PLATFORMS FOR GENERATIVE AI Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.	**7 Hours**
Practical Component: • Text-to-Text Generation using Pre-trained Language Models (LLMs) • Text-to-Image Generation using Diffusion-Based Models • Text-to-Code Generation and Explainable AI	**8 Hours**
ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.	**5 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours:60

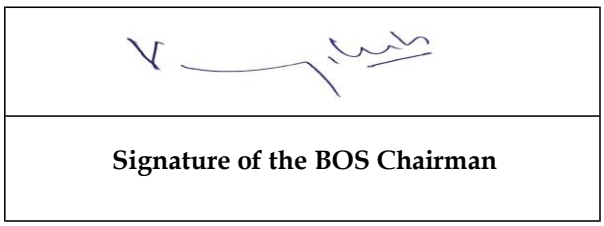
Learning Resources

Textbooks:

1. Keras, Rafael Valle "Hands-on Generative Adversarial Networks" Packt Publisher, 2019
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville "Deep Learning" , MIT Press, 2016.

References:

1. David Foster ,"Deep Learning: Teaching Machines to Paint, Write, Compose and Play" 2023. 2nd edition. O'Reilly Media, Inc.



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Online Educational Resources:
1. https://www.coursera.org/learn/generative-ai-introduction-and-applications?specialization=generative-ai-for-everyone 2. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone?specialization=generative-ai-for-everyone 3. https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms?specialization=generative-ai-for-everyone 4. https://www.coursera.org/learn/generative-ai-ethical-considerations-and-implications?specialization=generative-ai-for-everyone

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Chandrakala	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAE620	RESPONSIBLE AI	L	T	P	J	C
		3	0	0	0	3
PE		SDG	4			

Pre-requisite courses	24CAI507 Automation and Artificial Intelligence	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Understand fundamental AI concepts, ethical considerations, biases, and real-world limitations.
2	Apply ethical principles and interpretability methods to ensure responsible and transparent AI systems.
3	Design inclusive, privacy-aware AI systems using ethical reasoning and governance frameworks.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Comprehend the fundamental concepts of AI, recognize ethical considerations, and analyze biases and limitations through real-world case studies.	Ap
CO2	Apply ethical theories and principles to implement responsible AI practices, emphasizing accountability, responsibility, and transparency.	Ap
CO3	Evaluate the importance of interpretability, categorize methods, and apply them to models, ensuring effective communication of results.	Ap
CO4	Attain a comprehensive understanding of data privacy principles, employ effective privacy-preserving techniques in AI applications, and critically assess real-world instances emphasizing the equilibrium between privacy and utility	An
CO5	Assess ethical reasoning approaches, design moral agents, and implement ethical deliberation, governance, and inclusion for responsible AI practices.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	3	2	2		3	3	3
2	3	3	2	2	3		3	
3	3			2	2		3	3
4	3	3	2	2			3	3
5	3	3	2	2			3	3

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Course Content

INTRODUCTION Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis, limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness - AI harms – AI risks : Case Study.	**11 Hours**
ETHICAL DECISION MAKING Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI: Accountability, Responsibility, Transparency	**8 Hours**
INTERPRETABILITY AND EXPLAINABILITY Importance of Interpretability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.	**10 Hours**
PRIVACY PRESERVATION Introduction to data privacy - Methods of protecting data - Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning - Differential Privacy – Federated Learning – Case Study.	**8 Hours**
ENSURING RESPONSIBLE AI Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity.	**8 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

Textbooks:

1. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli, "Responsible AI in the Enterprise", Packt Publishing, 2023.
2. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 2019

References:

1. Christoph Molnar "Interpretable Machine Learning", Lulu, 1st edition, 2019.
2. Beena Ammanath, "Trustworthy AI", Wiley, 2022.

Online Educational Resources:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/introduction-to-responsible-ai?source=search.
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/responsible-ai-in-generative-ai?source=search

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

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Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Mrs. Shriaarthy AP/CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

Data Science, Analytics and Visualization

Signature of the BOS Chairman

24CAC621	PRINCIPLES OF DATA SCIENCE	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAI501- Database Management Systems	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Introduce the fundamental concepts and lifecycle of data science.
2	Apply descriptive statistics and exploratory data analysis to summarize data.
3	Analyze relationships between variables using correlation and regression.
4	Implement data wrangling and pre-processing techniques for cleaning raw data.
5	Gain practical experience applying data science concepts with modern tools.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Analyze the concepts of Data, Data Description, Relationship and Data Wrangling	An
CO 2	Apply appropriate statistical tests to evaluate hypotheses related to means, proportions and variances.	Ap
CO 3	Apply the knowledge on relationships between data.	Ap
CO 4	Apply the advanced Data Wrangling techniques for data.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	3	2					
2	3	2		2				
3	3	2	2					
4	3		2	2			2	2

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Course Content

INTRODUCTION Overview of Data science–Research goals–Building the model– presenting findings and building applications - Data Mining - Data Warehousing -Retrieving data–Data preparation Big Data and Data Science - Big Data Analytics, Business intelligence vs Big data, big data frameworks, Current landscape of analytics. **Practical Component:** • Set up the Python data science environment. • Load a dataset and perform initial inspection.	**8 Hours** **6 Hours**
DATA DESCRIPTION Exploratory Data Analysis -statistical measures- Representation- Data Analytics Lifecycle-Developing Initial Hypotheses-Identifying Potential Data Sources- testing hypotheses on means, proportions and variances. **Practical Component:** • Calculate key descriptive statistics for a dataset. • Create histograms and box plots for data visualization. • Conduct a basic hypothesis test to compare sample means.	**6 Hours** **8 Hours**
DESCRIBING RELATIONSHIPS Correlation–Scatterplots–correlationcoefficientforquantitativedata–computationalformula for correlation coefficient – Regression –Regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –Regression towards the mean. **Practical Component:** • Visualize relationships using scatter plots and correlation heatmaps. • Build and evaluate a simple linear regression model.	**8 Hours** **8 Hours**
ADVANCED DATAWRANGLING Strings–Datetimes–Hierarchical Indexing–Visualizing data Frames – Pandas Profiling – Data Transformation-handling Null values-categorical values-Data Aggregation-Data Filtering-handling Outliers. **Practical Component:** • Handle missing values and encode categorical features. • Filter data subsets and transform datetime columns. • Aggregate data using groupby and manage outliers.	**8 Hours** **8 Hours**

Theory	Tutorial	Practical	Project	Total
Hours: 30	Hours: 0	Hours: 30	Hours: 0	Hours:60

Learning Resources

Textbooks:

1. Cielen, David., Meysman, Arno D. B., and Ali, Mohamed., Introducing Data Science., Manning Publications, Shelter Island (2016).
2. Witte, Robert S. and Witte, John S., Statistics, Eleventh Edition., Wiley Publications, Hoboken (2017).

References:

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1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

Online Educational Resources:

1. https://www.coursera.org/specializations/data-science
2. https://www.coursera.org/professional-certificates/fractal-data-science

Assessment (Embedded Course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle Tests, Viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Rupashini P R, Assistant Professor, Department of Artificial Intelligence and Data Science	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC622	DATA PROCESSING TECHNIQUES	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAI501- Database Management Systems	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Analyze principles of large-scale and distributed data processing.
2	Implement real-time data streaming pipelines using Apache Kafka.
3	Apply Change Data Capture (CDC) for incremental data updates.
4	Leverage in-memory computing with Apache Spark for high-speed analytics.
5	Design scalable data pipelines using batch, streaming, and in-memory techniques.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Analyze the data processing concepts in data science.	An
CO 2	Apply the Real time data processing in machine learning model.	Ap
CO 3	Illustrate the change Data capture Techniques and Strategies in Incremental Processing.	An
CO 4	Apply the Learning algorithms for incremental processing in data.	Ap
CO 5	Correlating the Traditional disk system with an In-Memory Database.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	3	2					
2	2		3	2				
3	2		3	2				
4	2	3	2				2	2
5			2			3		

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Course Content	
DATA PROCESSING Overview of Data processing in Data science–Importance of Efficiency and Scalability – challenges in Big Data Processing–Parallel and Distributed Processing –Apache Hadoop– Map reduce –Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing. **Practical Component:** • Implement a MapReduce Word Count in Python. • Perform data preprocessing and cleaning with pandas.	**8 Hours** **8 Hours**
REAL-TIME DATA PROCESSING Streaming Data Architectures–Message Brokers –Pub/Subsystems–Queues– Apache-Kafka for Real Time Data streaming– Producers-consumers-Kafka connect for Data Integration-stream processing-Frame works-Real Time analytics -Machine learning models. **Practical Component:** • Develop a Kafka producer to stream live data. • Create a Kafka consumer to process data in real-time.	**7 Hours** **6 Hours**
INCREMENTAL PROCESSING Incremental processing in Data science–Change Data Capture Techniques (CDC)-Strategies- Delta Processing for incremental updates- Incremental Learning algorithms. **Practical Component:** • Simulate a Change Data Capture (CDC) pipeline. • Update an ML model using an incremental learning algorithm.	**7 Hours** **8 Hours**
IN-MEMORY PROCESSING Principles of In-Memory Processing- comparisons of Traditional Disk-based systems -In-Memory database and data structures- In-Memory computing in Spark- Resilient Distributed datasets(RDD) and Data frames- In-Memory analytics with SAP HANA- Performance Tuning and optimization. **Practical Component:** • Perform data transformations using Spark RDDs. • Process data with Spark DataFrames and compare performance.	**8 Hours** **8 Hours**

Theory Hours:30	Tutorial Hours:-	Practical Hours:30	Project Hours:-	Total Hours:60

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Learning Resources

Textbooks:

1. Saxena, Shilpi and Gupta, Sharub., Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka, 1st Edition., Packt Publishing, Birmingham (2017).
2. Karau, Holden and Warren, Rachel., High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark, 1st Edition., O'Reilly Media, Sebastopol (2017).

References:

1. Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka", by Shilpi Saxena and Sharub Gupta, 1st Edition, Kindle Edition 2017.
2. Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data" by Ralph Kimball and Joe Caserta, 1st Edition 2004.
3. Building a Scalable Data Warehouse with Data Vault 2.0, by Dan Linstedt ,2015.
4. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark, by Holden Karau, Rachel Warren, 1st edition, 2017.

Online Educational Resources:

1. https://www.coursera.org/specializations/big-data
2. https://www.coursera.org/learn/spark-python

Assessment (Embedded Course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle Tests, Viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr.Sudharson D, Associate Professor, Department of Artificial Intelligence and Data Science

Recommended by BoS on	16/08/2024		
Academic Council Approval	No. 27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC623	DATA MODELING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAI501 Database Management Systems	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Design and implement dimensional data models using tools like MySQL Workbench.
2	Apply logical data modeling principles and advanced design patterns.
3	Model complex relationships using graph and temporal database concepts.
4	Analyze and select appropriate NoSQL databases for specific use cases.
5	Design and implement geospatial data models for location-based analytics.

Course Outcomes		
After successful completion of this course, the students shall be able to:		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply MySQL Workbench to design database model.	Ap
CO 2	Apply logical Data model to design Patterns.	Ap
CO 3	Design Geospatial data models for applications involving location-based analytics	An
CO 4	Analyze and choose appropriate NoSQL and NewSQL databases for specific modeling requirements.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1					3			
2					3			
3	3	3	3			3		
4	3	3	3		3			

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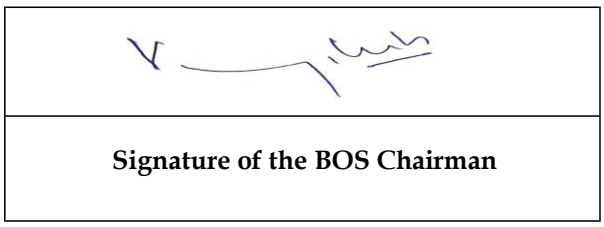
Course Content

INTRODUCTION TO ADVANCED DATA MODELING Overview of Data Modeling in Data science– Importance of Advanced data Modeling – Types of data Model– Dimensional modelling-Design-MySQL Workbench-Build Data model using MySQL workbench–Forward Engineering Feature-Converting Data model into Database schema, MySQL to reverse Engineering schema. **Practical Component:** • Design a star schema model in MySQL Workbench. • Reverse engineers an existing database to generate a visual ERD	**6 Hours** **6 Hours**
LOGICAL DATA MODEL Cross enterprise Analysis- Modern Driven analysis -Baseline data patterns-complex data Patterns-Generation of Entity Types -Transition from meta data to data-static vs dynamic Entity types-data coupling -cohesion. **Practical Component:** • Design a logical ERD for a university registration system. • Normalize a flat-file table into Third Normal Form (3NF).	**6 Hours** **6 Hours**
ADVANCED DATA PATTERNS Advanced subtype variations-Multi recursive networks-conditional Recursions-Rules based entity types-state Transition rules-Meta patterns. **Practical Component:** • Implement and query a recursive hierarchy using a self-join. • Model a supertype/subtype relationship for different person types.	**6 Hours** **6 Hours**
GRAPH AND TEMPORAL DATA MODELING Graph Databases – Nodes – Edges – Properties– Graph query Languages – Understanding Temporal Databases–Valid time vs Transition Time–Temporal Datamining Techniques– Temporal query languages; No-SQL-New SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations. **Practical Component:** • Perform CRUD operations on an embedded document in MongoDB. • Model a social network and find "friends of a friend" with SQL.	**6 Hours** **6 Hours**
GEOSPATIAL AND METADATA MODELING Representing geospatial data in models-Geospatial Query Language-Applications in Mapping and Location-based Analytics-Metadata Definition and Importance-Encryption and Masking in Data Models-Access Controls and Authorization **Practical Component:** • Execute a geospatial query to find locations within a given radius. • Implement role-based access control with SQL GRANT/REVOKE commands	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60



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Learning Resources

Textbooks:

1. Kimball, Ralph and Ross, Margy., *The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rd Edition*., Wiley, Hoboken (2013).
2. Hoberman, Steve., *Data Modeling Made Simple: A Practical Guide for Business & IT Professionals, 2nd Edition*., Technics Publications, Basking Ridge (2009).

References:

1. Kimball, Ralph and Ross, Margy., "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition., Wiley, (2013).
2. Kleppmann, Martin., Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems., O'Reilly Media, Sebastopol (2017).
3. Hoberman, Steve., "Data Modeling Made Simple: A Practical Guide for Business & IT Professionals", 2nd Edition., Technics Publications, (2009).

Online Educational Resources:

1. https://www.coursera.org/learn/advanced-data-modeling
2. https://www.coursera.org/learn/nosql-databases
3. https://www.coursera.org/specializations/databases-for-data-scientists
4. https://www.coursera.org/learn/sql-data-science

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Mr. Bhuvaneshwaran A, Assistant Professor, Department of Artificial Intelligence and Data Science

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC624	BUSINESS INTELLIGENCE FOR DECISION MAKING	L	T	P	J	C
		2	0	2	0	3
PE		SDG	8,9			

Pre-requisite courses	24CAI501- Database Management Systems	Data Book / Code book (If any)	NIL

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the end-to-end business analytics lifecycle from problem definition to deployment
2	Use Business Intelligence tools and OLAP for effective data-driven decision support.
3	Apply predictive analytics models for business forecasting and competitive analysis.
4	Implement analytics techniques for HR management and supply chain optimization.
5	Utilize analytics to drive marketing strategies and improve sales performance.

Course Outcomes		
After successful completion of this course, the students shall be able to :		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Analyze the real world business problems and model with analytical solutions.	An
CO 2	Evaluate the business processes for extracting Business Intelligence.	An
CO 3	Apply predictive analytics for business fore-casting.	Ap
CO 4	Apply analytics for supply chain and logistics management.	Ap
CO 5	Use analytics for marketing and sales.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	3	2					
2		3	2			2		
3			3	2		2		
4			3	2		2		
5			3	2		2		

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Course Content

INTRODUCTION TO BUSINESS ANALYTICS Analytics and Data Science – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration **Practical Component:** • Formulate a business problem and define its key performance indicators (KPIs). • Perform data cleaning and preparation on a raw business dataset using Python.	**6 Hours** **6 Hours**
BUSINESS INTELLIGENCE Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions. **Practical Component:** • Create a data cube from a dataset and perform OLAP operations (slice, dice). • Build an interactive BI dashboard with charts and filters using Tableau or Power BI.	**6 Hours** **6 Hours**
BUSINESS FORECASTING AND COMPETITIVE ANALYSIS Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models– Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics- Industry analysis- Profit Frontier, Risk vs Return, Competition Positioning- Enterprise Diagnosis **Practical Component:** • Develop a time-series model to forecast future monthly sales. • Build a classification model to predict customer churn based on historical data.	**6 Hours** **6 Hours**
HR ANALYTICS Human Resources – Planning and Recruitment – Training and Development - Supply chain network-Planning, Demand, Inventory and Supply–Logistics–Analytics applications in HR-Applying HR Analytics to make a prediction of the demand for talent. **Practical Component:** • Analyze employee data to identify key factors influencing attrition. • Develop a model to predict the demand for talent in different departments.	**6 Hours** **6 Hours**
MARKETING &SALES ANALYTICS Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process –Sales Planning– Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales. **Practical Component:** • Perform customer segmentation using clustering based on RFM (Recency, Frequency, Monetary) analysis. • Build a predictive model to score sales leads based on their likelihood to convert.	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours:60

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Learning Resources

Textbooks:

1. James, R. Evans., *Business Analytics, 2nd Edition*., Pearson, London (2017).
2. Prasad, RN and Acharya, Seema., *Fundamentals of Business Analytics, 2nd Edition*., Wiley, New Delhi (2016).

References:

1. Kotler, Philip and Keller, Kevin., "Marketing Management", 15th edition, PHI, 2016.
2. Rao, VSP., "Human Resource Management", 3rd Edition, Excel Books, 2010.
3. Mahadevan B., "Operations Management - Theory and Practice", 3rd Edition, Pearson Education, 2018.

Online Educational Resources:

1. https://www.coursera.org/learn/data-analytics-business
2. https://www.coursera.org/learn/foundations-of-business-intelligence
3. https://www.coursera.org/specializations/bi-foundations-sql-etl-data-warehouse

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Ms.Preethi G, Assistant Professor, Department of Artificial Intelligence and Data Science

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC625	DATA ETHICS AND PRIVACY	L	T	P	J	C
		3	0	0	0	3
PE		SDG	10,16			

Pre-requisite courses	24CAI501 - Database Management Systems	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	Identify and analyze the societal impact and risks of algorithmic bias.
2	Apply foundational ethical frameworks to data science projects.
3	Analyze the critical balance between data accuracy and individual privacy.
4	Understand privacy-preserving techniques to defend against data attacks.
5	Evaluate data privacy solutions within legal frameworks like General Data Protection Regulation.

Course Outcomes		
After successful completion of this course, the students shall be able to :		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Develop an awareness of the impact of data-related decisions on individuals and society.	C
CO 2	Identify the challenges and consequences of Biased datasets.	An
CO 3	Examine the importance of Data security and Accuracy.	Ap
CO 4	Apply the aspects of distributed data and associated risks.	Ap
CO 5	Apply the knowledge of encryption for data.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1		2					3	2
2	2	3					2	
3	2	2	3					
4		2	3				2	
5			3	2			2	

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Course Content	
DATABIAS Introduction- Data vs Information vs Facts- Algorithmic Bias- Privacy- Biased Datasets- Purpose of Corporation/AI-Fairness, Predictive Analytics & Mistakes -Surveillance & Power- Disparate Treatment/Impact	**8 Hours**
ETHICS IN DATA SCIENCE Ethics in data management- Role of AI Ethics in Corp- Privacy & Shared Responsibility- Surveillance/Power and Shared Responsibility- Disparate Treatment/Impact- Economics of Trust- Transparency vs accountability.	**9 Hours**
ACCURACY AND PRIVACY Creating & Measuring Accuracy-Data Science Ethics-Data Science Hate Privacy-Respecting Data Science- Misconceptions About Data Science Ethics- Accountability and Governance-Data Provenance and Aggregation	**10 Hours**
PRIVACY ATTACKS Defining Differential Privacy- Privacy Loss- Privacy attacks- Types of privacy attacks- Privacy-Aware Machine Learning and Data Science- Architecting Privacy in Data and Machine Learning-Open Source Libraries for PPML Projects- Distributed Data- Federated Learning	**9 Hours**
DATA ENCRYPTION FOR PRIVACY Encrypted Computation- Types of Encrypted Computation- Real-World Encrypted Computation- Navigating the Legal Side of Privacy- GDPR: An Overview- Privacy and Practicality Considerations- Getting Practical: Managing Privacy and Security Risk.	**9 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Textbooks:

1. Loukides, Mike., Mason, Hilary., and Patil, DJ., Ethics and Data Science., O'Reilly Media, Sebastopol (2018).
2. Jarmul, Katharine., Practical Data Privacy., O'Reilly Media, Inc., Sebastopol (2023).

References:

1. O'Neil, Cathy., Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy., Crown, New York (2016).
2. Kearns, Michael, and Roth, Aaron., The Ethical Algorithm: The Science of Socially Aware Algorithm Design., Oxford University Press, New York (2019).
3. Dwork, Cynthia, and Roth, Aaron., The Algorithmic Foundations of Differential Privacy., now Publishers Inc., Boston (2014).
4. Solove, Daniel J., Understanding Privacy., Harvard University Press, Cambridge (2008)

Online Educational Resources:

1. https://www.coursera.org/learn/data-science-ethics
2. https://www.edx.org/learn/ethics/the-linux-foundation-ethics-in-ai-and-big-data
3. https://ethics-of-ai.mooc.fi/

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Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.Thirumal P C, Associate Professor, Department of Information Technology	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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Network and Distributed Computing

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24CAC626	SMART CONTRACT DEVELOPMENT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAT 506 Cyber Security	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the Ethereum ecosystem, its components, and the role of the Ethereum Virtual Machine in executing smart contracts.
2	Learn the structure and lifecycle of smart contracts and develop them using Solidity programming language.
3	Apply development tools such as Remix, Truffle, and Ganache for building and deploying decentralized applications (DApps).
4	Integrate smart contracts with front-end applications using Web3.js and evaluate deployed DApps for functionality and performance.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Interpret Ethereum components required to design a smart contract	Ap
CO 2	Design and develop smart contracts using Solidity programming.	Ap
CO 3	Create and deploy a DApp on a Ethereum test network.	Ap
CO 4	Deploy and manage Ethereum blockchain networks using Ganache and Truffle.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3					2		
2	3		2			3	3	
3	3	2	2	2	3	2	2	3
4	3	3	3	2	3	3	2	3

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Course Content

ETHEREUM FOUNDATIONS Ethereum Eco System – Components – Ethereum Virtual Machine (EVM) – Ethereum and Turing Completeness – Smart Contract Basics – Smart Contract Lifecycle – Structure of Smart Contract. Ether currency units - Ethereum wallets – Ethereum accounts – Ethereum Tokens – Transactions, Gas and Fees – Ethereum mining - Externally owned accounts and contracts. **Practical Component:** • Getting Started with MetaMask a. Creating a Wallet b. Interacting with Remix IDE c. Switching Networks d. Getting some Test Ethers e. Sending Ether from MetaMask f. Exploring the transaction details of an account	**8 Hours**
SMART CONTRACT DEVELOPMENT Building a smart contract with Solidity – Ethereum Contract ABI – Programming with Solidity: Data Types & Variables – Operators – Control Structures - Predefined Global variables – Storage & Memory - Contracts – Functions – Function Modifiers - Constructor – Inheritance - Events and logs – Error handling - Inter-contract execution - Libraries and Ethereum package manager – Tokens - Introduction to Ethereum Name Service (ENS) – Designing Smart Contracts. **Practical Component:** • Building smart contract using Solidity, compiling and deploying it on Remix IDE • Use of setter and getter functions to interact with the contracts. • Smart contract to withdraw funds from a contract to a restricted account, preferably the owner's, with different levels of security restrictions.	**11 Hours**
BUILDING DAPP AND WEB 3 Running an Ethereum Client: Go Ethereum (Geth) - Processing and deploying smart contracts in Remix IDE. Introduction to Web3 - Using the web3.js javascript library - Generating Ethereum accounts. Truffle Framework & Ganache: Environment Setup for Truffle & Ganache, Truffle Project Creation, – Truffle Compile – Migrate and Create Commands - Decentralized App Creation: Smart Contract Creation, Front-End Creation, Connecting Smart Contract with Front-End Application – Deploying DApp – Validation – Testing of DApp. **Practical Component:** Build a DApp and deploy a smart contract on an external blockchain by using Ganache and Truffle. Interact with a front end developed using Web 3.js.	**11 Hours**

Theory Hours:30	**Tutorial Hours: 0**	**Practical Hours:30**	**Project Hours: 0**	**Total Hours:60**

Learning Resources

Text Books:

1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, Gavin Wood, 2018, O'Reilly Media
2. Modi, Ritesh, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd, United Kingdom
3. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018

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Online Educational Resources:
1.https://www.coursera.org/learn/decentralized-apps-onblockchain?specialization=blockchain 2. https://www.coursera.org/learn/smarter-contracts#syllabus 3. https://101blockchains.com/course/smart-contracts-development 4. https://www.tcsion.com/courses/industry-honour-course/ethereum-smart-contracts/ 5. https://onlinecourses.swayam2.ac.in/aic21_ge01/preview 6. https://trufflesuite.com/docs/truffle/

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. J. Cynthia, Professor, CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAE627	DECENTRALIZED FINANCE	L	T	P	J	C
		3	0	0	0	3
PE		SDG	9			

Pre-requisite courses	24CAT506 Cyber Security	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the limitations of centralized finance and the foundational infrastructure of decentralized finance systems.
2	Learn the fundamental primitives of DeFi such as tokens, swaps, loans, and their role in blockchain-based financial systems.
3	Learn various DeFi operations including lending, decentralized exchanges, staking, and smart contracts to build decentralized financial solutions.
4	Examine decentralized identity models and assess different types of risks and security measures in DeFi ecosystems.
5	Evaluate the regulatory landscape, governance mechanisms, and ethical considerations surrounding DeFi platforms and real-world use cases.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Interpret the features of decentralized finance required to build its infrastructure.	Ap
CO 2	Examine key trends and basic primitives of decentralized finance to design innovative financial solutions.	Ap
CO 3	Apply diverse DeFi operations for providing blockchain-based financial solutions.	Ap
CO 4	Identify the risks associated with decentralized finance.	Ap
CO 5	Analyse ethical and regulatory issues associated with Decentralized Finance.	An

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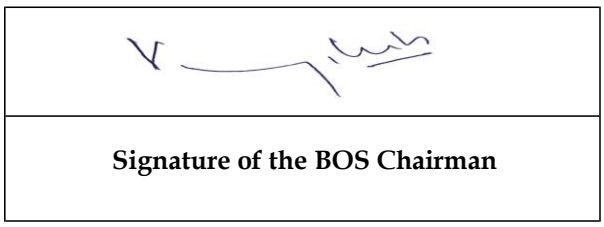
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2							
2	3	2						2
3	3	2			2			
4	2				2		2	
5	2				2		2	

Course Content

DECENTRALIZED FINANCE(DEFI) INFRASTRUCTURE Issues in Centralized Finance – History and Overview of Decentralized Finance - Overview of Cryptocurrency – Cryptographic hashing – Proof of work – Smart Contracts – Gas - Stable coins – Tokenomics – Altcoins - Blockchain and DeFi	**8 Hours**
DEFI PRIMITIVES Transactions – Fungible tokens – non-fungible tokens – custody – Supply adjustment – Incentives – Swap – Collateralized loans – Flash loan - Problems solved by DeFi- Ineffeciency – Limited Access – Opacity – Centralized control and lack of Interoperability	**8 Hours**
DEFI OPERATIONS Credit /Lending and borrowing protocols – Decentralized Exchanges – Derivatives – Tokenization – Hot and cold wallets – Moving centralized exchanges funds to blockchain - Automated market makers – Bridging – Staking – Oracles	**10 Hours**
DECENTRALIZED IDENTITY AND SECURITY Decentralized Identity (DID) – Security risks and measures in DeFi – Smart contract risk - Governance risk – Oracle risk – scaling risk – DEX risk – Custodial risk – Regulatory risk. Smart Contract Auditing – Yield Farming strategies – Liquidity mining	**10 Hours**
REGULATORY AND ETHICAL CONSIDERATIONS Global Regulations – Ethical issues – DAO – Government mechanisms – Crypto hackers – DeFi Usecases -Case study: Crypto Exchange Platforms and Gitcoin	**9 Hours**

Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45



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Learning Resources

References:

1. Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, Vitalik Buterin, "DeFi and the Future of Finance", Wiley 1st Edition.
2. Melanie Swan, Blockchain: Blueprint for a new economy, Shroff Publisher/O'Reilly Publisher.
3. Ron Quaranta, Blockchain in Financial Markets and Beyond: Challenges and Applications, Risk Books Publisher.
4. Richard Hayen, Blockchain & FinTech: A Comprehensive Blueprint to Understanding Blockchain & Financial Technology - Bitcoin, FinTech, Smart Contracts, Cryptocurrency, Risk Books Publisher.

Online Educational Resources:

1. https://www.udemy.com/course/masteringdefi/
2. https://www.coursera.org/specializations/decentralized-finance-duke
3. https://101blockchains.com/ebooks/decentralized-finance-defi-guide/

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr. J. Cynthia, Professor, CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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Cloud Computing

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24CAC628	VIRTUALIZATION AND RESOURCE MANAGEMENT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understanding the basic concepts of virtualization, recognize various types of virtualization
2	Learning cost models, pricing strategies and other economic factors of cloud computing.
3	Exploring development and deployment of applications using services offered by public cloud platforms.
4	Understanding how to evaluate application requirements and select the most suitable cloud service models.
5	Analyzing the features, compliance, performance, and pricing of different cloud service providers.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Analyze the use of different resource virtualizations used in cloud environment.	An
CO2	Apply the factors of cloud economics on migration and development.	Ap
CO3	Develop applications in different public cloud platform.	Ap
CO4	Select appropriate service model for an application.	Ap
CO5	Choose a suitable cloud service provider based on application domain.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	3		2				
2	2		2			3		
3	2		3	2				
4	3	2		2				
5	2	3	2					

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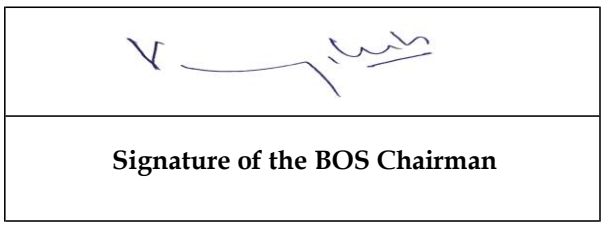
Course Content	
VIRTUALIZATION Roles of Virtualization, Hypervisor, Types of Virtualization – Server virtualization – Storage virtualization – Network virtualization – Desktop virtualization – Application Virtualization. **Practical Component:** • Demonstrate the virtualization by enabling the OS virtualization on single machine by creating instances oracle virtual box/VMware. • Installation of VM Ware/ virtual box and implement multiple OS.	**6 Hours** **6 Hours**
CLOUD ECONOMICS AND MIGRATION Cost models and optimization, Economies of Scale, Resource Optimization, Reduced Capital Expenditure - Total Cost of Ownership (TCO), Cost Transparency and Management, Risk Mitigation and Security, Performance vs. Cost Trade-offs. Cloud Migration Strategies, Iterative Seven-step Model of Migration into the Cloud, Assessment and Planning, Choosing the Right Cloud services and Provider, Change Management and Training, Performance and Monitoring, Testing and Validation, Backups, Post-Migration Optimization. **Practical Component:** • Configuring a cloud network	**6 Hours** **6 Hours**
INFRASTRUCTURE AS A SERVICE Compute: AWS EC2, Azure Virtual Machines, Google Compute Engine. Containers – Microservices, Docker, Kubernetes containers. Storage: Amazon EBS, Amazon S3, Azure disk storage, Google cloud storage. Autoscaling – AWS autoscaling, Azure app service, Google compute engine. Load balancing – AWS ELB, Azure traffic manager, Google cloud load balancer. Network: Amazon VPC, Azure virtual network, Google cloud VPN. **Practical Component:** • Creating VMs in public cloud. • Deploying application in Docker/Kubernetes.	**6 Hours** **6 Hours**
PLATFORM AS A SERVICE PaaS: Serverless computing - AWS Lambda, Azure functions, Google Cloud functions, AWS Apprunner, Elastic beanstalk, Google App engine, Google Cloud Functions, Amazon RDS, DynamoDB, Azure SQL database, Azure CosmosDB, Google cloud SQL, Google cloud database. **Practical Component:** • Static Web site hosting • Dynamic Website hosting • Balancing network traffic using load balancer	**6 Hours** **6 Hours**
SOFTWARE AS A SERVICE Amazon chime, Workmail, Workdocs, Microsoft 365, Microsoft power platform, Azure active directory, Azure DevOps, Azure IoT central, Azure cost management, Google Maps platform, Google workspace, Google analytics, Google cloud identity, Google Cloud search, Firebase. **Practical Component:** • Scale the Compute resource with auto scaling • E-mail notification using serverless architecture.	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60



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Learning Resources

Textbooks:

-

References:

1. Dr. Rajesh Kumar Pathak , “Cloud Computing Fundamentals, Notion Press, 2023.
2. A. B. Lawal, “Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications”, A. B. Lawal publication, 2020.
3. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing: Foundations and Applications Programming”, Morgan Kaufmann publications, 2013.
4. Cloudonomics: The Business Value of Cloud Computing" by Joe Weinman, John Wiley & Sons Inc, 2012.
5. Mastering AWS Development" by Uchit Vyas, Ingram short title, 2015.
6. Microsoft Azure Essentials - Fundamentals of Azure, Second Edition" by Michael Collier and Robin Shahan, Microsoft Press, 2015.
7. Google Cloud Platform for Developers: Build highly scalable cloud solutions with the power of Google Cloud Platform" by Ted Hunter and Steven Porter, Packt Publishing Limited, 2018.

Online Educational Resources:

1. https://www.coursera.org/learn/cloud-computing-basics
2. https://www.coursera.org/learn/meta-cloud-computing
3. https://www.coursera.org/learn/cloud-computing-foundations-duke
4. https://www.coursera.org/browse/information-technology/cloud-computing
5. https://www.mygreatlearning.com/cloud-computing/courses
6. http://www.infocobuild.com/education/audio-video-courses/computer-science/CloudComputing-IIT-Kharagpur/lecture-12.html
7. https://www.coursera.org/specializations/aws-fundamentals
8. https://www.coursera.org/learn/cloud-azure-intro
9. https://www.coursera.org/learn/gcp-infrastructure-foundation

Assessment (Embedded course)

SA I, SAII, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
-	-	Dr.R.Kalaiselvi, Assistant Professor, CSE

Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC629	CLOUD INFRASTRUCTURE AND ARCHITECTURE	L	T	P	J	C
		2	0	2	0	3
PC		SDG	9			

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the fundamental components of private cloud architecture
2	Exploring to set up and configuring a small-scale cloud environment
3	Learning to assess and evaluate the security mechanisms and vulnerabilities associated with services and applications
4	Understanding the configuration and management of various cloud storage solutions in a private cloud setup.
5	Introducing cloud management tools and platforms to build environments that automate, monitor, and manage IT resources effectively.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Construct the architecture for a private cloud.	Ap
CO 2	Develop a cloud environment at small scale.	Ap
CO 3	Inspect Security of services and applications in private cloud.	An
CO 4	Make use of concepts and features related to Virtualized datacentre to configure cloud storage.	Ap
CO 5	Build environment to manage IT resources.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2		3	2				
2		2	3	2				
3	2	3		2				
4	2		2	3				
5			2	3	2			

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Course Content

INTRODUCTION TO CLOUD INFRASTRUCTURE Introduction to cloud Infrastructure/virtual infrastructure, General Architecture of virtual infrastructure: Architecture of OpenStack, project, services, mode of deployment, workflow, OpenStack Components: Nova, Swift, cinder, Neutron, Glance, Keystone, Horizon Virtualization environment with KVM. OpenStack API. **Practical Component:** • Build a horizon node – Monitor node	**8 Hours** **7 Hours**
CLOUD COMPUTE ARCHITECTURE Configuring Horizon Dashboard, OpenStack CLI client - Create and manage flavours, compute instances, generate and manage SSH keys, accessing instances, configure an instance with a floating IP address, create instances with security groups, manage Nova host consoles, instance snapshots. OpenStack image service: image repository, manage images, metadata, image types, bundling, exporting, migrating images. **Practical Component:** • Configure NOVA compute Node	**8 Hours** **8 Hours**
CLOUD STORAGE ARCHITECTURE Swift: features, architecture of swift, swift installation and configuration, data management lifecycle, backup and archival, media storage with swift. Use the command line client to upload and manage files to Swift containers, manage permissions on a container in object storage, Cinder: Architecture of cinder clock storage, Volume provisioning and management- create and manage volumes, attach volumes to instances, manage volume quotas, backup and restore volumes, manage volume snapshots. **Practical Component:** • Configure Swift object storage, Construct a cinder block node	**7 Hours** **8 Hours**
CLOUD NETWORK ARCHITECTURE Software defined networking, Neutron Architecture, Manage network resources, create external/public networks, create project networks, create project routers, attach routers to public and project networks, manage network services for a virtual environment, manage network quotas, manage network interfaces on compute instances, create and manage project security groups and rules, assign security group to instance, create and manage floating IP addresses, assign floating IP address to instance, detach floating IP address from instance. Identity and access management- keystone: users, roles, groups. **Practical Component:** • Launching an instance- Register an account at openstack, Create SSH Key, validate network. • Sharing project environment among multiple users.	**7 Hours** **7 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	**Hours: 0**	**Hours: 30**	**Hours: 0**	**Hours:60**

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Learning Resources
Textbooks:
-
References:
1. Ben Silverman, Michael Solberg, “OpenStack for Architects: Design Production-ready Private Cloud Infrastructure”, 2nd Edition, Packt Publishing, 2018. 2. Michael Solberg, Ben Silverman, “OpenStack for Architects”, Packt Publishing,· 2017 3. Alok Shrivastwa, Sunil Sarat, Kevin Jackson, Cody Bunch, Egle Sigler, Tony Campbell, “OpenStack: Building a Cloud Environment”, Packt Publishing, 2016. 4. James Denton, “Learning OpenStack Networking (Neutron)”, Packt Publishing, 2015.
Online Educational Resources:
1. https://www.coursera.org/learn/juniper-openstack-and-kubernetes?

Assessment (Embedded course)
SA I, SAII, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.R.Kalaiselvi, Assistant Professor, CSE	
Recommended by BoS on	16/082024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC630	CLOUD STORAGE MANAGEMENT	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4			

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understanding the integration of various cloud storage technologies into real-world applications for efficient data handling and scalability.
2	Exploring different storage networking technologies.
3	Introducing foundational design principles of virtualization in managing and optimizing cloud computing resources effectively.
4	Learning different cloud storage life cycle strategies.
5	Understanding different backup and disaster recovery solutions.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Make use of cloud storage technologies in applications.	Ap
CO 2	Correlate different storage networking technologies.	Ap
CO 3	Make use of the design principles of virtualization techniques in cloud resource management.	Ap
CO 4	Analyze different cloud storage life cycle strategies.	An
CO 5	Select appropriate backup and recovery strategies.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2		2	3				
2	3	2		2				
3	2		3	2				
4		3	2	2				
5	2		3	2				

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Course Content

INTRODUCTION TO CLOUD STORAGE Overview of cloud storage concepts - Advantages and challenges of cloud storage - Comparison of traditional storage vs. cloud storage, Evolution of Storage Architecture, Data Center Infrastructure, Storage Technologies**:** Block, file, and object storage - Storage protocols (iSCSI, NFS, SMB, etc.) - Data replication, snapshots, and backups in the cloud**.** **Practical Component:** • Attaching volume to instances.	**7 Hours** **7 Hours**
STORAGE NETWORKING TECHNOLOGIES Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance, File-Level Virtualization. Fibre Channel Storage Area Networks: Fibre Channel Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE **Practical Component:** • Creating snapshots for volumes.	**8 Hours** **8 Hours**
LIFE CYCLE MANAGEMENT AND SECURITY Introduction to storage tiers**,** Different Storage Classes Offered by Cloud Providers - Choosing the Right Storage Class for Different Use Cases - Access Control and Security - Identity and Access Management (IAM) - Encryption in Transit and at Rest **Practical Component:** • Migrating a file among different storage classes. • Managing access control over a file/storage.	**8 Hours** **8 Hours**
BACKUP AND DISASTER RECOVERY Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture. **Practical Component:** • Enabling client and server side encryption for an object.	**7 Hours** **7 Hours**

Theory Hour:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

Learning Resources

Textbooks:

-

References:

1. Data Intensive Storage Services for Cloud Environments by Athanasios Voulodimos, Dimosthenis P. Kyriazis, Spyridon V. Gogouvitis, Theodora Varvarigou, Business Science Reference, 2013.
2. Cloud Storage Management in Contemporary IT Environments by Michael O'Dell and Michael Corey, Packt Publishing, 2012.
3. Borko Furht, Armando Escalante Handbook of Cloud Computing, Springer Science+Business Media, LLC 2010.

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4. Information Storage and Management by Emc Education S, John Wiley & Sons, Incorporated, 2012.
Online Educational Resources:
1. https://www.coursera.org/learn/data-storage-microsoft-azure 2. https://www.udemy.com/course/introduction-to-cloud-storage-apps-a-beginners-course/ 3. https://www.coursera.org/learn/cloud-storage-big-data-analysis-sql 4. https://www.classcentral.com/course/linkedin-learning-learning-cloud-computing-cloud-storage-30444

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.S.Kanagaraj, Assistant Professor, IT	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC631	CLOUD APPLICATION DEVELOPMENT	L	T	P	J	C
		2	0	0	2	3
PE		SDG	9			

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Exploring real-world scenarios where cloud application development provides strategic benefits
2	Understanding the difference between traditional web applications and cloud-native applications
3	Learning design and development of cloud-enabled applications using APIs, serverless components
4	Introducing agile methodologies and DevOps practices for managing the full life cycle of cloud applications

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Analyse the use cases for cloud application development.	An
CO2	Compare web and cloud applications and analyze appropriate cloud platforms requirements.	Ap
CO3	Build applications using APIs and Cloud services.	Ap
CO4	Apply agile application development and manage application life cycle using DevOps .	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2	3	2					
2	2		3	2				
3	2		3	2				
4			2		3	2		

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Course Content	
INTRODUCTION TO APLLICATION DESIGN Business case for implementing cloud application, Requirements, collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud inter-operability and standards, scalability and fault tolerance, security, trust and privacy.	**6 Hours**
APPLICATION DEVELOPMENT FRAMEWORK Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, CloudFoundry.	**8 Hours**
CLOUD SERVICE DELIVERY ENVIRONMENT AND API Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API. **Architecting for the Cloud :** Best practices Best practices in architecture cloud applications in AWS cloud, Amazon Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds.	**8 Hours**
DEVOPS IN CLOUD Continuous Integration/Continuous Deployment (CI/CD), collaboration among development, operations, and other stakeholders, Agile and lean principles: Embracing agile methodologies and lean practices to enable faster development and delivery cycles. Automating development pipelines, Monitoring and Logging, Implementing monitoring solutions for cloud applications, Containerization: Docker basics and container orchestration with Kubernetes.	**8 Hours**
Project: Projects involving Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry services will be done.	**30 Hrs**

Theory	Tutorial	Practical	Project	Total
Hours:30	**Hours: 0**	**Hours: 0**	**Hours:30**	**Hours:60**

Learning Resources
Textbooks:
-
References:
1. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud by George Reese, Oreilly Publication, 2021. 2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2020.
Online Educational Resources:
1. https://www.coursera.org/specializations/ibm-cloud-application-development-foundations 2. https://www.udemy.com/course/cloud-computing-development-essentials/ 3. https://www.coursera.org/learn/cloud-native-devops-agile-nosql?specialization=ibm-cloud-application-development-foundations 4. https://www.edx.org/certificates/professional-certificate/ibm-cloud-and-application-development-foundations

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Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr. L. Dhanabal, Assistant Professor, MCA	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC632	CLOUD SECURITY	L	T	P	J	C
		2	0	2	0	3
PE		SDG		9		

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understanding common security breaches and vulnerabilities across Infrastructure, Platform, and Software as a Service models.
2	Learning and implementing encryption techniques and identity and access management (IAM) policies to ensure secure administrative control in cloud systems
3	Understand and assess the principles and practices of regulatory compliance, cloud governance, and risk management in enterprise cloud security strategies.
4	Exploring the integration of security practices into continuous integration and continuous deployment (CI/CD) pipelines for secure software delivery.
5	Introducing unique security challenges and protection strategies in edge computing environments.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Analyze the security breaches of IaaS, PaaS and SaaS.	An
CO2	Apply various data encryption methods and security mechanisms to get the administrative control using IAM service.	Ap
CO3	Inspect compliance, governance and risk management	An
CO4	Make use of CI/CD pipeline in application security	Ap
CO5	Analyze security in edge computing	An

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Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1		3		2			2	
2	2		2	3				
3		3				2	2	
4			2	3	2			
5		3		2				2

Course Content

INTRODUCTION TO CLOUD SECURITY Overview of cloud computing and its security challenges - Importance of cloud security for organizations - Shared responsibility model in cloud security. Cloud Service Models and Security**:** Security considerations for IaaS, PaaS, and SaaS, Risks and security measures specific to each service model, Case studies highlighting security vulnerabilities in cloud services. **Practical Component:** • Securing free tier account in cloud platform • Securing free tier account in cloud platform with IAM user	**6 Hours** **6 Hours**
CLOUD SECURITY ARCHITECTURE AND DATA PROTECTION Designing secure cloud architectures, Identity and access management (IAM) in the cloud Network security in a cloud environment. Encryption techniques for data at rest and in transit Key management best practices, Data loss prevention (DLP) strategies in the cloud **Practical Component:** • Creating IAM role, Group. • Securing free tier account setting billing in cloud platform	**6 Hours** **6 Hours**
COMPLIANCE, GOVERNANCE, AND RISK MANAGEMENT Compliance requirements in the cloud (e.g., GDPR, HIPAA), Risk assessment and management in cloud environments, Implementing governance frameworks for cloud security, Cloud-specific threats and vulnerabilities, Security monitoring and logging in the cloud, Incident response planning and execution in cloud environments. **Practical Component:** • Securing instances in cloud platform within Virtual Private Cloud • Implementing role based access control with cloud platform IAM	**6 Hours** **6 Hours**
MODULE Name: SECURE DEVELOPMENT AND DEVSECOPS Security considerations in cloud-native application development, Implementing security in CI/CD pipelines, Best practices for DevSecOps in the cloud. **Practical Component:** • Securing instances with firewall rules	**6 Hours** **6 Hours**

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• Data encryption and decryption using cloud platforms	
MODULE Name: EMERGING TRENDS AND FUTURE OF CLOUD SECURITY Edge computing and its security implications, Zero-trust security models in the cloud, Future directions and trends in cloud security **Practical Component:** • Securing and restricting access to storage • Configuring networking firewall for an application	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours: 0	Practical Hours:30	Project Hours: 0	Total Hours:60

Learning Resources
Textbooks:
-
References:
1. Cloud Security Attacks, Techniques, Tools and Challenges by Preeti Mishra, Emmanuel S Pilli, R C Joshi · 2021 2. Cloud Security: Concepts, Applications and Perspectives by Brij B. Gupta · 2021. 3. Securing the Cloud: Cloud Computer Security Techniques and Tactics by Vic (J.R.) Winkler 4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines · 2010 5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice) 1st Edition, by Tim Mather (Author), Subra Kumaraswamy (Author), Shahed Latif (Author) 2009.
Online Educational Resources:
2. https://www.coursera.org/learn/cloud-security-basics 3. https://www.coursera.org/learn/sscp-4th-ed-course-6 4. https://www.coursera.org/learn/cloud-data-security 5. https://www.checkpoint.com/cyber-hub/cloud-security/what-is-cloud-security/ 6. https://www.zscaler.com/resources/security-terms-glossary/what-is-cloud-security 7. https://medium.com/@goodycyb/exploring-cloud-security-in-depth-labs-and-insights-for-aws-and-gcp-50ca038478c4 8. https://goodycyb.hashnode.dev/

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Ms.R.Asmitha Sree, Assistant Professor, CSE	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

Signature of the BOS Chairman

24CAC633	CLOUD AUTOMATION	L	T	P	J	C
		2	0	0	2	3
PE		SDG		9		

Pre-requisite courses	24CAT505- Cloud Computing	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understanding various cloud automation tools and enable them to evaluate and select the appropriate toolset based on application needs.
2	Exploring methods to integrate automation into the DevOps lifecycle
3	Introducing cloud-based automation techniques to implement and manage storage provisioning, backup, and lifecycle tasks
4	Learning to configure and use monitoring and alerting tools for performance analysis, fault detection, and service availability in cloud applications.
5	Exploring the usage of cloud-native and third-party tools for auto-scaling, load balancing, and resource optimization in dynamic cloud environments.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Identify appropriate cloud automation tools for an application.	Ap
CO 2	Take part in automating DevOps using tools.	An
CO 3	Make use of storage automation in an application.	Ap
CO 4	Apply automation tools in monitoring services.	Ap
CO 5	Utilize tools for the cloud resource scaling and management.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	2		2	3				
2			3	2	2			

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3			3	2		2		
4			2	3		2		
5			3	2		2		

Course Content	
INTRODUCTION CLOUD AUTOMATION Benefits of cloud automation - Types of cloud automation tools - Use cases for cloud automation. Managing and provisioning infrastructure through code (using tools like Terraform, Ansible, Puppet, Chef), Automating code integration and verification through tools like Jenkins, GitLab CI, or CircleCI, Automating the deployment process to push code changes into production environments reliably.	**7 Hours**
CLOUD RESOURCE SCALLING AND STORAGE AUTOMATION Automating resource allocation, de-allocation, and right-sizing of resources based on usage. Kubernetes - Salt -CircleCI - Ansible and puppet, AWS Data Sync, Azure Data Factory**.**	**8 Hours**
CLOUD AUTOMATION TOOLS FOR DEVOPS DuploCloud - Puppet - Heroku -HashiCorp, Monitoring and Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.	**7 Hours**
CLOUD DEPLOYMENT AUTOMATION NetApp Cloud Volumes ONTAP - CFEngine -VMware vs Realize Automation - Cisco Intelligent - Automation for Cloud - Microsoft Azure Automation - Google Cloud Deployment Manager - AWS CloudFormation - IBM Cloud Schematics	**8 Hours**
Project: Projects involving different cloud platform services like Puppet, Heroku, HashiCorp and monitoring & Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.	**30 Hours**

Theory Hours:30	**Tutorial Hours: 0**	**Practical Hours: 0**	**Project Hours: 30**	**Total Hours:60**

Learning Resources

Textbooks:

-

References:

1. Mikael Krief,, “Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps”,Packt Publishing; 1st edition, 2019.
2. Marcelo Pinheiro, “Mastering DevOps Automation”, Packt Publishing Limited, 2018.
3. Jeff Geerling, “Ansible for DevOps: Server and Configuration Management for Humans”, Midwestern Mac, LLC; 1st edition, 2015.
4. John Rhoton and James Stanger, “Cloud Automation and DevOps: Transforming Your IT Environment, 2015.

Online Educational Resources:

1. https://www.coursera.org/learn/automation-in-aws
2. https://www.coursera.org/learn/gcp-infrastructure-scaling-automation

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3. https://www.udemy.com/course/aws-cloud-security-proactive-way/
4. https://www.edx.org/learn/computer-programming/google-cloud-elastic-google-cloud-infrastructure-scaling-and-automation

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Dr.S.Kanagaraj, Assistant Professor, IT	
Recommended by BoS on	16/082024		
Academic Council Approval	No.27	**Date**	24/08/2024

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Web and Software Development

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24CAC634	UI AND UX DESIGN	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	-	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the basic concepts and differences between UI and UX design.
2	Learn to apply design thinking and empathy techniques.
3	Gain skills in visual design and UI component creation.
4	Practice wireframing, prototyping, and usability testing.
5	Use tools like Figma to build interactive user interfaces.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Understand the difference between UI and UX design to explain the significance of empathy techniques in gathering user insights.	U
CO 2	Apply UI design principles to implement visual design standards and UI components to enhance user interaction.	Ap
CO 3	Understand UX research techniques to align user and business goals with the industry-based design process.	U
CO 4	Apply wireframing and prototyping techniques to create and test responsive designs.	Ap
CO 5	Apply essential concepts of Figma to create interactive user centred design.	Ap

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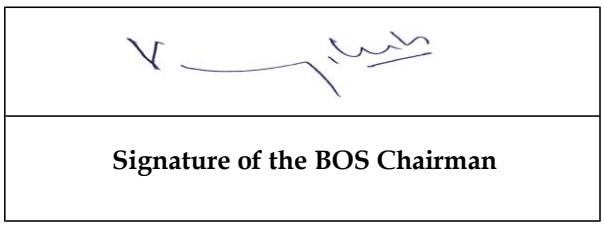
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1	3	2						2
2		2	3	2				
3	3	2						2
4		2	3	2				
5			3	2				2

Course Content	
INDUSTRY-RELEVANT DESIGN THINKING Understanding UI vs. UX Design, Design Thinking Framework, Innovative Thinking Methods, Empathy Techniques for User Insights. **Practical Component:** • Identify a customer problem and perform Design Thinking Process for a new product and Defining the Look and Feel of the new Project	**6 Hours** **6 Hours**
UI DESIGN PRINCIPLES FOR INDUSTRY Visual Design Standards, UI Components and Design Patterns, User Interaction and Engagement, Integration and Style Guides.Branding **Practical Component:** • Exploring various UI Interaction Patterns to Design a Responsive layout with proper UI Style Guides	**6 Hours** **6 Hours**
UX RESEARCH AND STRATEGY IN THE INDUSTRY UX Fundamentals for Business Impact Design Process, Industry Research Techniques, Aligning User and Business Goals. **Practical Component:** • Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)	**6 Hours** **6 Hours**
WIREFRAMING, PROTOTYPING AND TESTING Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wire flows -Building a Prototype - Building High-Fidelity Mock-ups - Designing Efficiently with Tools - Interaction Patterns- Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings -Prototype Iteration. **Practical Component:** • Developing Wireflow diagram for application and Designing a User Interface with Figma	**6 Hours** **6 Hours**



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LOW CODE -NO CODE TOOLS Low code- No code Tools Essential Concepts of Figma - Setup and Configure Figma - Images, Shapes, and Tools - Working with Figma - Figma Components - Styles and Libraries in Figma - Cards and Layout Grids in Figma. **Practical Component:** • Creating and Managing Layout Grids and Components in Figma.	**6 Hours** **6 Hours**

Theory	Tutorial	Practical	Project	Total
Hours:30	**Hours: 0**	**Hours: 30**	**Hours: 0**	**Hours:60**

Learning Resources
Textbooks:
1.Jon Yablonski, Laws of UX: Using Psychology to Design Better Products & Services, O'Reilly, 2021.
References:
1. Joel Marsh, UX for Beginners, O'Reilly, 2022. 2. Don Norman, The Design of Everyday Things: Revised and Expanded Edition, Basic Books, 2013. 3. Steve Krug, Don't Make Me Think: A Commonsense Approach to Web Usability, New Riders, 2014. 4. Jeffrey Zeldman and Ethan Marcotte, Responsive Web Design, A Book Apart, 2011. 5. Kim Goodwin, Designing for the Digital Age: How to Create Human-Centered Products and Services, Wiley, 2009.
Online Educational Resources:
1. https://www.coursera.org/learn/designing-user-interfaces-and-experiences-uiux

Assessment (Embedded course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
-	-	Ms. Nivetha R Assisstant Professor. Dept of Computer Science	
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	**Date**	24/08/2024

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24CAC635	PRINCIPLES OF DEVOPS	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9			

Pre-requisite courses	Bridge Course	Data Book / Code book (If any)	-

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the DevOps Principles and Version Control
2	Learn Architecture Models and Serverless Computing
3	Gain skills in Continuous Integration with Jenkins
4	Implement configuration management practices using Ansible
5	Leverage Docker to build, customize, and deploy containerized applications

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply DevOps principles to meet software development requirements.	Ap
CO 2	Understand different actions performed through Version control tools like Git.	U
CO 3	Apply the microservices architecture in the DevOps Environment.	Ap
CO 4	Apply continuous integration and continuous deployment using Jenkins and docker.	Ap
CO 5	Analyse the use of configuration management tools like Ansible to distinguish between different approaches to infrastructure.	An

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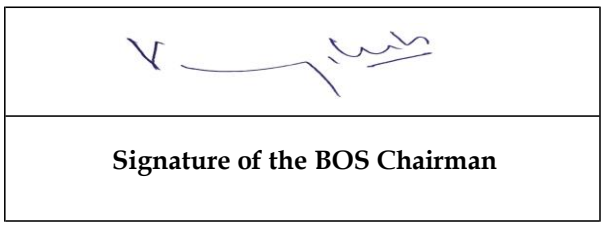
Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)							
	1	2	3	4	5	6	7	8
	Foundation Knowledge	Problem Analysis	Development of Solutions	Modern Tool Usage	Individual and Teamwork	Project management and Finance	Ethics	Life-long Learning
1		2	3	2				
2	3			2				2
3			3	2	2			
4			2	3	2			
5		3	2					2

Course Content

INTRODUCTION TO DEVOPS Overview of DevOps-DevOps Lifecycle-Essential Characteristics of DevOps- Tools and Technologies-Social Coding Principle-Version control systems: Git and GitHub-Importance of version control in CICD pipeline.	**6 Hours**
Practical Component: • Installation and setup of Git.-Creating repositories, committing changes, branching and merging. • Collaborating with GitHub: Forking, Pull Requests, and Issues -Hands-on practice of managing a small project using Git and GitHub	**6 Hours**
MICROSERVICES Monolith vs SOA vs Microservices - Microservices- Microservices Patterns - Introduction to Serverless Computing- Introduction to the FaaS Model- The Serverless Framework.	**6 Hours**
Practical Component: • Designing a basic microservice architecture for a sample application- Deploying a simple serverless function using AWS Lambda (or a similar local serverless framework)- Hands-on exercise in designing microservices patterns for an e-commerce or blog app	**6 Hours**
CONTINUOUS INTEGRATION USING JENKINS Essentials of Continuous Integration- Jenkins tool Management- Installing Jenkins-Architecture- Creating a Jenkins Job- Configuration- Customizing Jenkins with plugins-database user creation Creating a Jenkins Build and Jenkins workspace.	**6 Hours**
Practical Component: • Installation and initial setup of Jenkins on a virtual machine or cloud environment. -Creating freestyle and pipeline jobs -Integrating GitHub projects with Jenkins. -Installing and configuring useful plugins (Git plugin, Pipeline plugin, etc.)- Setting up a basic CI job that pulls code from GitHub and builds a project.	**6 Hours**
CONFIGURATION MANAGEMENT Introduction - Infrastructure as Code- Configuration Management Tools- Automating Infrastructure Provisioning-Introduction to Ansible – Installation and Configuration- Ansible Architecture, Ansible and Infrastructure Management	**6 Hours**



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Practical Component: • Installing Ansible on a Linux machine- Writing and executing basic Ansible ad-hoc commands- Creating Ansible playbooks to automate the setup of servers (like web servers, databases)- Managing multiple servers using inventory files.-Using Ansible roles for modular playbooks	**6 Hours**
CONTINUOUS DEPLOYMENT Overview of Docker-Benefits of Docker Workflow- Process Simplification-Architecture- Docker Containers-Docker Workflow- Anatomy of Dockerfile-Building an Image-Running an Image-Custom base Images, Storing Images. **Practical Component:** • Installing Docker on Linux/Windows-Building and running containers from existing images-Writing Dockerfiles to containerize sample applications- Pushing custom images to Docker Hub- Integrating Docker containers into Jenkins for continuous deployment pipelines.	**6 Hours** **6 Hours**

Theory Hours:30	Tutorial Hours:0	Practical Hours:30	Project Hours: 0	Total Hours:60

Learning Resources

Textbooks:

1. Gene Kim, Jez Humble, Patrick Debois, John Willis, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations ,Second Ediiton,2021

References:

1. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4. Sricharan Vadapalli, Modern DevOps Practices: Implement, Secure, and Manage DevOps Processes,2024.
5. Rafal Leszko, Continuous Delivery with Docker and Jenkins,Third Edition,2023

Online Educational Resources:

1. https://www.coursera.org/professional-certificates/devops-and-software-engineering
2. https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-softwareengineering
3. https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-softwareengineering
4. https://www.jenkins.io/user-handbook.pdf

Assessment (Embedded course)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce.

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Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
-	-		Ms. Nivetha R Assisstant Professor. Dept of Computer Science
Recommended by BoS on	16/08/2024		
Academic Council Approval	No.27	Date	24/08/2024

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OPEN ELECTIVES

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P18CAO0001	Modern Financial Strategies and Innovations	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 9			

Pre-requisite: Nil

Faculty Name:	**Mayuri P T**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course covers essential financial principles and concepts useful for both personal and corporate finance.
2	This course provides an in-depth introduction to the ideas, methods, and institutions that help manage risks and foster enterprise in financial markets.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understanding the financial principles and concept of Finance	U
CO 2	Equip learners with the financial decision-making skills.	Ap
CO 3	Evaluate company performance using profitability, efficiency, leverage, and other ratios.	E
CO 4	Assess the working capital needs of the business.	An
CO 5	Manage risks and foster enterprise in financial markets.	Ap

MODULE	**Hours**
FINANCIAL STATEMENTS AND CASHFLOWS Introduction to Finance- Balance sheet - Assets, Liabilities, and Stockholders & Equity-Income Statement- Profit & loss- Cash flows -Sources and use of cashflows- Liquidity Leverage Ratios- Turnover Ratios- Profitability Ratios-Financial Ratios: Market Value Ratios- Financial Forecasting.	**9**

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TIME VALUE OF MONEY Introduction to Time Value of Money-Present Value (PV) and Future Value (FV)- difference between the quoted interest rate and effective annual rate- Annual Percentage Rate (APR) -Effective Annual Interest Rate (EAR)-Annuity and perpetuity- Applications of time value of money.	**9**
VALUATION AND CAPITAL BUDGETING Basic terms of bonds-Interest Rates-Zero Coupon bonds- Types of Bonds- Bond Ratings- structure of bond market- Basic Concepts of Stock- Parameter Estimation- Growth Opportunities- P/E ratio-Stock Markets- Tax salvage value - Opportunity Costs- Sunk Costs- Side Effects- Capital Budgeting with Example.	**9**
RISK AND RETURN Historical record of return and risk- Trade-off between risk and return-Calculate return and risk-Systematic risk and unsystematic risk- Beta Coefficient- Valuation & Risk Estimation- The Capital Asset Pricing Model.	**9**
FINANCIAL MARKETS Financial Markets Introduction- Distribution and Outliers- Insurance Fundamentals-Forecasting--Introduction to Behavioural Finance- Prospect Theory- Leverage- Shares and Dividends- Investment Banks Introduction- Importance of Financial Theory.	**9**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources
Reference books/ Web Links
1. Introduction to Finance by Lawrence J. Gitman, Jeff Madura 2. The Financial Times Guide to Investing: The definitive companion to investment and the financial markets by Glen Arnold
Online Resources
1. https://www.coursera.org/learn/introduction-to-finance-the-basics 2. https://www.coursera.org/learn/financial-markets-global 3. https://www.coursera.org/learn/introduction-to-finance-the-role-of-financial-markets

Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated By			
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**		**Internal Expert(s)**
-	-		Ms. Mayuri P T, MBA-IEV
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	24.08.2024

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P18CAO0002	Sports Analytics and Emerging Technologies	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 8			

Pre-requisite: Nil

Faculty Name:	**Asmitha Shree R**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/asmitha-shree**

Course Objectives:	**The purpose of taking this course is to:**
1	To provide a foundational understanding on the relation between sports and society.
2	To enable students to apply core marketing principles in the context of sports.
3	To develop analytical skills for comparing sports marketing with other sectors.
4	To foster an understanding of the influence of data-driven decision-making in sports.
5	To develop critical thinking and problem-solving skills in sports management.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the social dynamics, cultural identity, and globalization's impacts on the sports world.	U
CO 2	Understand the Evolution and Commercialization of Sports.	U
CO 3	Apply Marketing Principles to Sports.	Ap
CO 4	Analyse and differentiate between sports marketing and other marketing industries.	An
CO 5	Understanding Machine Learning Workflow in sports analytics.	U
CO 6	Apply regression analysis and machine learning models to predict sports outcomes.	Ap

Module	**Hours**
THE SOCIAL DYNAMICS OF SPORTS Exploring the concepts of games, play, and sports - Analyzing the impact of globalization, nationalism, and politics in sports - Understanding race, cultural identity, and their influence on the sports world.	**8**
THE EVOLUTION AND COMMERCIALIZATION OF SPORTS Examining the rise of women's sports, gender, and sexuality - Investigating why sports captivate global audiences - Understanding the mega business of sports- outdoor sports-extreme sports, and the search for adventure.	**8**
INTRODUCTION TO THE SPORTS MARKETING Introduction to the Sports Marketing- Sports Marketing Challenges- Marketing Basics Applied to Sports Marketing- The Traditional 4 P's: A Meaningful Update for Sports- Fan Marketing- Influence Marketing: Sports- Service vs. Product Marketing in Sports- Sports Marketing versus other Marketing Industries- Event Marketing & Management.	**9**
ENTERTAINMENT MARKETING Entertainment Marketing -Business Marketing- Creating Creative Content-Virtual Reality and Over the Top TV, Entertainment Branding (Placement) -Digital Viral Marketing- Dangers of Viral Marketing- Personal Entertainment Experience- Virtual Reality.	**10**
PREDICTION MODELS WITH SPORTS	**10**

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Machine Learning-The Machine Learning Workflow- Model: NHL Game Outcomes-Introduction to Regression Analysis -Building the Logistic Regression Model-Interpreting Regression Results - Considerations in Deploying The Model-Case Study: Regression Analysis - Batsman's performance and salary , Regression Analysis - Batsman's performance and salary ,Regression Analysis with Cricket Data.	

Theory	Tutorial	Practical	Project	Total
Hours:45	Hours: 0	Hours: 0	Hours: 0	Hours:45

Learning Resources
Textbooks
1. Grant Jarvie., Sport, Culture and Society: An Introduction., Taylor & Francis, (4th Edition, 2021). 2. Matthew D. Shank and Mark R. Lyberger., Sports Marketing: A Strategic Perspective., Routledge, (6th Edition, 2021). 3. Thomas W. Miller Machine Learning and Data Mining for Sports Analytics, Pearson Education, Inc,(2017).
Reference books/ Web Links
1. Richard Giulianotti ,The Globalization of Sport: The Politics, Economics, and Culture of Sports", (2005) 2. Manfred Bruhn, Peter Rohlmann , "Sports Marketing: Fundamentals - Strategies – ,Springer, Instruments", (2022).
Online Resources
1. https://www.coursera.org/learn/international-entertainment-sports-marketing 2. https://www.coursera.org/learn/sports-marketing 3. https://www.coursera.org/learn/prediction-models-sports-data#modules 4. https://www.coursera.org/learn/machine-learning-sports-analytics 5. https://www.coursera.org/learn/foundations-sports-analytics#modules

Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Assessment	
Formative	Continuous
Assignments / Mini project, Quiz, Lab	Case Studies

Course Curated By			
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**		**Internal Expert(s)**
-	-		Ms. Asmitha Shree, CSE
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	24.08.2024

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P18CAO0003	Healthcare Innovation and Technology	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

Faculty Name:	**G. Shobana**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**www.linkedin.com/in/shobana-g-0425b348/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand Healthcare Systems and their Challenges.
2	Explore Ethical and AI-driven Approaches in Healthcare.
3	Investigation of Healthcare Marketplace Dynamics.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the structure and functions of healthcare systems, along with the associated ethical and technological frameworks.	U
CO 2	Understand the implementation and challenges of electronic health records (EHR) and eHealth models.	U
CO 3	Analyse Healthcare Market Dynamics over time.	An
CO 4	Examine Insurance and Medical Technology Markets and the impact of technological advancements on healthcare delivery and policy.	An
CO 5	Understand the global medical innovations, their impact, and the trends shaping the healthcare industry.	U

Module	**Hours**
INTRODUCTION TO HEALTHCARE SYSTEMS Overview of healthcare systems-Issue in healthcare – patients-Intermediaries -providers-challenges in healthcare access and delivery- Characteristics of Physician Practices -healthcare organizations and functions- Procedure Codes and Diagnosis Codes- Payment Systems- EMRs, EHRs, and PHRs-	**6**

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Stereotypical Plan Design- Public and Private Plans- Ethical frameworks - AI in health care delivery and payment structure.	
EHR MANAGEMENT SYSTEM eHealth -model -challenges- Future scope- Collecting the data- Clinical use of personal health data- Mobile apps -social media apps -design of eHealth solutions-Evaluating health apps- Data and digital health records- Anatomy-Predictive and precision medicine- Privacy and security- performance- Interacting with healthcare professional – Advantages -Telehealth- personalize healthcare-EHR applications- patient journey -Features- Login, Authentication, Credentialing- Clinical Decision Support-types- CDS Committees-Introduction to Databases-Components of a SQL Server-EHR Interfaces- Training- Communications- Change Management.	**12**
HEALTHCARE MARKETPLACE Marketplace Overview, Healthcare Spending Drivers, Quality Trends, Market Evolution-Health Cost Growth- Issues -Effects of Health Behaviours. **Physician and hospital Service Market: Provider** Market Overview-Price Discrimination- Physician Market Evolution-Physician Sites of Care- Physician-Hospital Market Evolution: Hospital Features-Scale and Scope, Hospital Issues, Quality and Safety- Hospital Future Trends, Policy Impact on Hospitals.	**10**
INSURANCE AND MEDICAL TECHNOLOGY MARKET Risky Business, Utility of Wealth- working of Insurance model- Moral Hazard and Adverse Selection-Early Public Health Insurance- Healthcare Laws and Regulations (HIPAA, FDA, etc.) Quality and Safety Standards in Healthcare-Role of Policy -Future Health Reform. **Medical Technology Market**: Device- Drug-Medical Device Evolution-Medical Devices -Vision -New Technology Make Money-Measuring Medical Technology Value -FDA Approval for Pharmaceuticals- FDA Approval for Medical Devices- Drive Towards Cost-Effectiveness-preparing a Global Health Technology -Pharma & Device Convergence-Medical Technology Market.	**10**
GLOBAL MEDICAL INNOVATION Globalization of the Medical Industry, Medical Tourism Evolution & Growth, Medical Tourism in India, Key Issues, Health Bads and Their Consequences-Goals of Health Information Technology-Value of Health Information Technology- Insurer Information Technology- Provider Information Technology-Integrated Health Care Delivery-Key Questions for an Innovation Valuation-Technology-Secure- Return Investment on Technology.	**7**

Theory	Tutorial	Practical	Project	Total
Hours:45	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:45**

Learning Resources

Reference books/ Web Links

1. Robert E. Hoyt, Ann K. Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Lulu.com (2019).
2. Peter M. Ginter, Linda E. Swayne, and Robert J. Duncan, Healthcare Systems: An Introduction, Health Administration Press (2018).
3. Sharon B. Buchbinder, Nancy H. Shanks, Introduction to Healthcare Management, Jones & Bartlett Learning (2017).
4. Richard Gartee, Electronic Health Records: Understanding and Using Computerized Medical Records, Pearson (2014).
5. Peter R. Kongstvedt, Healthcare Economics and Policy, Jones & Bartlett Learning (2013).

Online Resources

1. https://www.coursera.org/learn/intro-to-healthcare
2. https://www.coursera.org/learn/health-it-fundamentals
3. https://www.coursera.org/learn/ehealth
4. https://www.coursera.org/specializations/healthcare-marketplace

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Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated By			
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**		**Internal Expert(s)**
			Ms. G. Shobana, AP-II, IT
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	24.08.2024

Signature of the BOS Chairman

P18CAO0004	Corporate Strategy and Innovation	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 9			

Pre-requisite: Nil

Faculty Name:	**Ms. P. T Mayuri**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course is designed to help learners develop structured approaches to making sound strategic decisions in multi-business firms.
2	This focuses on modern practices in product management, especially for digital products.
3	It covers essential skills for product managers, emphasizing the need to understand customer needs, use actionable analytics, and apply agile methodologies.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Develop structured, decision-based frameworks for making key corporate strategy decisions.	Ap
CO 2	Understand how to make informed decisions about business diversification and entering new markets or industries.	U
CO 3	Learn how to design corporate headquarters that add value across business units.	Ap
CO 4	Develop the ability to leverage actionable analytics and user data to drive product decisions.	E
CO 5	Understand how to iterate and enhance digital products continuously, using feedback and analytics.	An

Module	**Hours**
CORPORATE ADVANTAGE Introduction to Corporate strategy- Understanding Differences: Number of Businesses, Corporate Advantage, Competition- Sum-of-the-parts Analysis- Corporate Strategy Decisions- value multi-business firms.	**9**

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DIVERSIFICATION AND DIVESTITURE Understanding the Basic Modes of Diversification- Diversification Test -Five-step Approach- Understanding the Basic Modes of Divestiture- Divestiture Test- Three-step Approach to the Divestiture Decision.	**9**
CORPORATE HEADQUARTERS Example of Corporate Headquarters- Controls of Corporate Headquarters- HQ Influence Models- Financial Perspective- Uncertainty Perspective- Synergy Perspective- Social Perspective- Synergistic Portfolio Framework.	**9**
FOCUS AND PRODUCT INNOVATING METHODS Introduction to Product Management Journey- Creating, Testing and Facilitating- Product Owner-Team Collaboration- Qualitative Analytics- Quantitative Analytics- Managing Habits- Customer Collaboration- Funnel Focus- Managing Product.	**9**
EXPLORING AND AMPLIFYING PRODUCTS Introduction to Exploring a new Product Idea- Building for learning- Horizons of growth- Corporate Innovation Pipeline- Business Model Design- Introduction to Amplifying an existing products- Business model types- Actionable analytics- Data science- Chanel - Modality- Roadmap.	**9**

Theory	Tutorial	Practical	Project	Total
Hours:45	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:45**

Learning Resources

Reference books/ Web Links

1. Competitive Strategy: Techniques for Analyzing Industries and Competitors, Michael E. Porter
2. User Experience Is Brand Experience: The Psychology Behind Successful Digital Products and Services by Felix Van De Sand, Anna-Katharina Frison, Pamela Zotz
3. Corporate Strategy and Product Innovation by Robert R. Rothberg

Online Resources

1. https://www.coursera.org/learn/corporatestrategy
2. https://www.coursera.org/learn/uva-darden-digital-product-management

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated By

Expert(s) from Industry	Expert(s) from Higher Education Institutions		Internal Expert(s)
-	-		Ms. Mayuri P T, MBA-IEV
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	24.08.2024

Signature of the BOS Chairman

P18CAO0005	Gamification and Gaming	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3, 4, 9			

Pre-requisite: Nil

Faculty Name:	**Dr. K. Saranya**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**Kumaraguru college of Technology**
LinkedIn profile	**https://www.linkedin.com/in/dr-saranya-k-b3a93313a/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand the core differences between Gamification and Games.
2	Explore how gamification drives innovation in business.
3	Analyse the effectiveness of gamification in Advocacy, Media, Politics, and Education.
4	Identify the risks and future trends in gamification.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Acquire in-depth knowledge of gamification principles and identify specific applications across various contexts.	U
CO 2	Develop a comprehensive conceptual framework for gamification tailored to different sectors.	C
CO 3	Critically analyse and evaluate the benefits and risks associated with gamification.	E
CO 4	Analyse the role of motivation in gamification and how it drives innovation in the game market.	An

Module	**Hours**
GAMIFICATION Core concepts, distinctions between gamification and games, Motivation in Gamification, Gamification drive Innovation, Game Market.	**9**
GAMIFICATION IN BUSINESS Business sector adopts gamification techniques -Case studies, features of gamification in business, marketing strategies.	**8**
GAMIFICATION FOR ADVOCACY AND MEDIA Applications in civil society, differences from business gamification, effectiveness in raising awareness, media outlets adopt gamification techniques, features of gamification in media, journalism and communication benefiting from gamification.	**10**

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Theory Hours:45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours:45

Learning Resources

Reference books/ Web Links

1. Yu-Kai Chou," Actionable Gamification: Beyond Points, Badges, and Leaderboards", Fremont (CA), 2014.
2. B. Burke, "Gamify: How Gamification Motivates People to Do Extraordinary Things", Bibliomotion, 2014.
3. J. Lerner, "Making Democracy Fun: How Game Design Can Empower Citizens and Transform Politics", Boston (MA), 2014.

Online Resources

1. https://www.coursera.org/specializations/esports
2. https://www.coursera.org/learn/gamification

Assessment (Theory course)

SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated By

Expert(s) from Industry	Expert(s) from Higher Education Institutions		Internal Expert(s)
-	-		Dr. K. Saranya, CSE
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	26.06.2025

Signature of the BOS Chairman

P18CAO0006	Environmental Innovations and Management	L	T	P	J	C
		3	0	0	0	3
OE		SDG	6, 15			

Pre-requisite: Nil

Faculty Name:	**Dr. N. Rajathi**
Designation:	**Professor**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/dr-rajathi-natarajan-7748758b/**

Course Objectives:	**The purpose of taking this course is to:**
1	Explore urbanization, climate change, sustainability, and circular economy principles in managing environmental challenges.
2	Understand integrated water resource management and pollution control in relation to environmental hazards and public health.
3	Investigate population dynamics, agriculture's impact on the environment, and ethical approaches to solving complex environmental issues.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Analyse and address the environmental challenges associated with global trends.	An
CO 2	Evaluate and apply integrated water resource management principles to address complex water-related challenges,	Ap
CO 3	Explain the impact of environmental hazards.	U
CO 4	Explain the relationship between global population dynamics, agriculture, and soil resources.	U
CO 5	Identify and apply environmental ethics and management principles to complex issues.	Ap

Module	**Hours**
GLOBAL TRENDS AND ENVIRONMENT MANAGEMENT Sustainability and the SDGs-Demographic Trends-Global urbanization-Environment Management -Cities and the rising sea level-Climate Change and Water-Circular Thinking in Waste Management-Plastic as Part of the Circular Economy-Stakeholder and Social Sustainability Analysis-–Utility Management -Environmental Management in Rural Areas-Phases in Solid Waste Management -Regulation -Outdoor and Indoor air pollution –Technologies for the environment built .	**9**
WATER RESOURCE MANAGEMENT AND POLICY The rules of resource, uses and their circumvention- Integrated water resource management to water-food-energy –Integrated Water shed management –water as source of conflict and cooperation.	**9**

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ENVIRONMENTAL HAZARDS AND GLOBAL PUBLIC HEALTH Air and water pollution –key concepts – controlling air pollution –key concepts in water pollution-controlling water pollution –physical hazards and soil waste - Solid Waste Disposal Methods-Hazardous Waste Disposal Methods-Population pressure –Build environment.	**9**
POPULATION, FOOD, AND SOIL Population the world- population changes-Global population – Global population dynamics - Agriculture and Environment – Agriculture and Human Nutrition- Modern Agriculture Effects and Alternatives -Soil and Environment –Soil resource and Profile.	**9**
ENVIRONMENTAL MANAGEMENT & ETHICS Introduction – Environmental Ethics- Environmental management of tame and wicked problems-Decision support tools-Environmental regulation and principles.	**9**

Theory	Tutorial	Practical	Project	Total
Hours:45	**Hours: 0**	**Hours: 0**	**Hours: 0**	**Hours:45**

Learning Resources

Reference books/ Web Links

1. Circular Economy for the Management of Operations. United States, CRC Press, (2020).
2. Pangare, Vasudha. Global Perspectives on Integrated Water Resources Management. India, Academic Foundation, (2006).
3. Hutchinson, Emma, and Kovats, Sari. Environment, Health and Sustainable Development. United Kingdom, McGraw-Hill Education, (2017).
4. Wild, Alan. Soils, Land and Food: Managing the Land during the Twenty-First Century. United Kingdom, Cambridge University Press, (2003).
5. Krishnamoorthy, Bala. Environmental Management: Text and Cases. India, Prentice Hall India Pvt., Limited, (2017).
6. Politics and Policies for Water Resources Management in India. United Kingdom, Taylor & Francis,(2020).

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Online Resources
1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview 2. https://www.coursera.org/learn/global-environmental-management 3. https://www.coursera.org/learn/water-management 4. https://www.coursera.org/learn/environmental-hazards-and-global-public-health 5. https://www.coursera.org/learn/population-food-and-soil 6. https://www.coursera.org/learn/environmental-management-ethics

Assessment (Theory course)
SA I, SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)

Course Curated By			
Expert(s) from Industry	**Expert(s) from Higher Education Institutions**		**Internal Expert(s)**
-	-		Dr. N. Rajathi, IT
Recommended by BoS on	16.08.2024		
Academic Council Approval	No. 27	**Date**	24.08.2024

Signature of the BOS Chairman