Department of

B.Sc., Data Science

ACADEMIC YEAR 2025-2026

I - VI Semesters

SCHEME AND SYLLABUS

B.Sc., DATA SCIENCE

UNDERGRADUTE

For

B.Sc., DATA SCIENCE PROGRAMME

(Semester Pattern)

LEARNING OUTCOMES - BASED CURRICULUMFRAMEWORK(LOCF)

Effective for the students admitted from the academic year

2025-2026 and onwards

DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE

(AUTONOMOUS)

Reaccredited with A++ Grade by NAAC

COLLEGE WITH POTENTIAL FOR EXCELLENCE, LINGUISTIC MINORITY INSTITUTION,

AFFILIATED TO UNIVERSITY OF MADRAS,

E.V.R. PERIYAR HIGH ROAD, ARUMBAKKAM, CHENNAI – 600106, TAMILNADU

CONTENTS

INSTITUTION

VISION

To impart value based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood

MISSION

To impart knowledge, enable the students acquire skills and imbibe values, develop their personality, mould their character, evoke a sense of empathy and social concern, and thereby help them evolve into humane and responsible citizens.

DEPARTMENT OF DATA SCIENCE

VISION

Delivering quality education, equipping students with cutting-edge computer skills to thrive in tech and society.

MISSION

M1	To foster a focused and friendly learning atmosphere.
M2	To provide the team-sprit and leadership qualities.
M3	Sharpening skills in Data science through analytical and applied learning.
M4	Enhancing skills through internships and industrial exposure

PROGRAM EDUCATIONAL OUTCOMES (PEOs)

PEO1	To help students to practice computer science in a broad range of industries.
PEO2	To provide students with an academic environment that fosters excellence, transparency, leadership and promote awareness of life-long learning
PEO3	To prepare students to succeed in employment/profession or to pursue postgraduate & research education in Computer Science

PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO1	PEO2	PEO3
M1	3	3	2
M2	2	2	3
M3	2	3	3
M4	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

PROGRAM OUTCOMS (PO) IN RELATION TO GRADUATE ATTRIBUTES

PO1	Apply knowledge of mathematics and computer science to analyze, design, and develop efficient computing solutions for complex real-world problems.
PO2	Identify, formulate, and investigate accounting problems and data analytics using appropriate research methods, tools, and techniques to derive effective and innovative solutions.
PO3	Utilize modern engineering tools, software, and technologies to design, implement, and evaluate computer-based systems with an understanding of their limitations and potential.
PO4	Understand and apply ethical principles and assess the societal, legal, and environmental impacts of computing technologies, promoting sustainability and responsible professional practices
PO5	Communicate effectively in both technical and non-technical contexts and function efficiently as an individual and as a part of diverse teams in multidisciplinary environments.
PO6	Demonstrate leadership qualities, project management skills, and a commitment to continuous learning to adapt to evolving technologies and global challenges in the computing field.

Mapping of POs TO PEOs

PEO/PO	PO1	PO2	PO3	PO4	PO5	PO6
PEO 1	3	3	3	3	3	3
PEO 2	3	3	3	2	3	3
PEO 3	3	2	2	3	3	2

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

PROGRAM SPECIFIC OUTCOMES(PSOs)

PSO1	Learning the applications of various software elements which help to identify various analysis and design methodologies
PSO2	Demonstrate by developing computer programs in the are related to algorithm, web designing, facilitating efficient design for complex problems.
PSO3	Enables the students to be familiar with the modern-day issues, latest trends in computing and technology and create ideas and solutions to existing problems
PSO4	Building code in various Programming Languages and applications
PSO5	Gains Knowledge in the various aspects of new Trends and Technologies.
PSO6	Ability to design and develop an application to meet the desired

DEPARTMENT OF DATA SCIENCE

ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of B.Sc., Data Science Programme shall be required to have passed the Higher Secondary Examinations under science stream with Physics, Chemistry, Mathematics and Computer Science (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereof by the Syndicate of the University of Madras.

DURATION OF THE COURSE:

The duration of the course for three academic years consisting of six semesters and each semester comprises 90 days.

a) Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixth semester respectively.

b) The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if he /she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years, passed the examinations all the Six-Semesters prescribed earning **142 credits**.

SCHEME ON EXAMINATIONS

As per the University Regulation the following split up of marks are to be followed.

(i) SPLIT UP FOR INTERNAL AND EXTERNAL MARKS FOR THEORY AND PRATICAL PAPER:

Sl. No.	Paper	Internal	External	Total
1.	Theory	50	50	100
2.	Practical	50	50	100

(ii) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR THEORY:

CIE- Continuous Internal Evaluation (50 Marks)

CIA	30
Generic Skill	15
Attendance	5
Total	50

SPLIT UP FOR INTERNAL AND EXTERNAL MARKS FOR THEORY AND PRATICAL PAPER:

Sl. No.	Paper	Internal	External	Total
1.	Theory	50	50	100
2.	Practical	50	50	100

SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR THEORY:

CIE- Continuous Internal Evaluation (50 Marks)

CIA	30
Generic Skill	15
Attendance	5
Total	50

SCHEME OF I SEMESTER B.Sc. DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs. Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	**AECC**		Language I	3	4	-	-	-	4	50	50	100
Part II	**AECC**		English I	3	4	-	-	-	4	50	50	100
Part III	**Core Course I**	2566101	Object Oriented Programming using Java	4	3	1	-	-	4	50	50	100
Part III	**Core Course II**	2566102	Modern Operating System	4	3	1	-	-	4	50	50	100
Part III	**Core Practical I**	2566103	Object Oriented Programming using Java Lab	2	-	1	3	-	4	50	50	100
Part III *	**Generic Elective I**		Statistical Methods and Its Applications	3	3	1	-	-	4	50	50	100
Part IV	**Skill Enhancement Course Discipline Specific I**	2566104	Advanced Excel	2	2	-	-	-	2	50	50	100
Part IV	**Skill Enhancement Course-Non Major Elective I -NME I-**	2566105	Programming Concepts and Techniques	2	2	-	-	-	2	50	50	100
Part IV **	**Soft Skills I**		Soft skills I	2	2	-	-	-	2	50	50	100
				25	**23**	**4**	**3**		**30**	**450**	**450**	**900**

CIA-Continuous Internal Assessment

ESE-End Semester Examination

*Syllabus framed and approved by Statistics Department

**Syllabus framed and approved by English Department

SCHEME OF II SEMESTER B.Sc. DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credi ts	Hrs. Distributio n				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	**AECC**		Language II	3	4	-	-	-	4	50	50	100
Part II	**AECC**		English II	3	4	-	-	-	4	50	50	100
Part III	**Core Course III**	2566206	Data Structures and Analysis of Algorithms	4	3	1	-	-	4	50	50	100
Part III	**Core Course IV**	2566207	Python for Data Science	4	3	1	-	-	4	50	50	100
Part III	**Core Practical II**	2566208	Python for Data Science Lab	2	-	1	3	-	4	50	50	100
Part III *	**Generic Elective II**		Probability and Statistics	3	3	1	-	-	4	50	50	100
Part IV	**Skill Enhance ment Course-Discipline Specific II**	2566209	Interactive Data Visualization	2	2	-	-	-	2	50	50	100
Part IV	**Skill Enhance ment Course - Non Major Elective II- NME II**	2566210	Principles of Open Source Software Development	2	2	-	-	-	2	50	50	100
Part IV **	**Soft Skills II**		Soft skills II	2	2	-	-	-	2	50	50	100
Total				**25**	**23**	**4**	**3**		**30**	**450**	**450**	**900**

CIA-Continuous Internal Assessment

ESE-End Semester Examination

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SCHEME OF III SEMESTER B.Sc., DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs. Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part III	**Core Course V**	2566311	Web Design and Development	4	4	1	-	-	5	50	50	100
Part III	**Core Course VI**	2566312	Fundamentals of Data Engineering	4	4	1	-	-	5	50	50	100
Part III	**Core Course VII**	2566313	Principles of Data Mining	4	4	1	-	-	5	50	50	100
Part III	**Core Practical III**	2566315	Data Mining Lab	2	-	1	3	-	4	50	50	100
Part III *	**Generic Elective III**		Optimization Techniques	3	3	1	-	-	4	50	50	100
Part IV	**Discipline Specific Elective-DSE I-Employability Course**	2566314(A)/ 2566314(B)/ 2566314(C)	A. Computer Networks/ B. Mobile Computing/ C. Artificial Neural Networks	3	3	1	-	-	4	50	50	100
Part IV	**IV**	2566316	Industrial Visit	1	-	-	-	-	-	-	-	-
Part IV	**EVS**		EVS	-	1	-	-	-	1	-	-	-
Part IV **	**Soft Skills III**		Soft skills III	2	2	-	-	-	2	50	50	100
Total				**23**	**21**	**6**	**3**		**30**	**350**	**350**	**700**

CIA-Continuous Internal Assessment
ESE-End Semester Examination

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SCHEME OF IV SEMESTER B.Sc., DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs. Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part III	**Core Course VIII**	2566417	Database Systems **(Also common to B.Sc. Computer Science & BCA)**	4	3	1	-	-	4	50	50	100
Part III	**Core Course IX**	2566418	Artificial Intelligence and Expert Systems	4	3	1	-	-	4	50	50	100
Part III	**Core Course X**	2566419	Cryptography	4	3	1	-	-	4	50	50	100
Part III	**Core Practical IV**	2566421	Database Systems Lab **(Also common to B.Sc. Computer Science & BCA)**	2	-	1	3	-	4	50	50	100
Part III	**Core Practical V**	2566422	Artificial Intelligence Algorithms Lab	2	-	1	3	-	4	50	50	100
Part III *	**Generic Elective IV**		Statistical Analysis Using R	3	3	1	-	-	4	50	50	100
Part III	**Discipline Specific Elective-DSE II-Entrepreneurship Course**	2566420(A) / 2566420(B) / 2566420(C)	(A) Business Analytics/ (B) Text Analytics/ (C)Social Network Analytics	3	2	1	-	-	3	50	50	100
Part IV	**EVS**		EVS	2	1	-	-	-	1	50	50	100
Part IV **	**Soft Skills- IV**		Soft skills - IV	2	2	-	-	-	2	50	50	100
Total				**26**	**17**	**7**	**6**	**-**	**30**	**450**	**450**	**900**

CIA-Continuous Internal Assessment
ESE-End Semester Examination

*Syllabus framed and approved by Statistics Department
**Syllabus framed and approved by English Department

SCHEME OF V SEMESTER B.Sc., DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs. Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part III	**Core Course XI**	2566523	Fundamentals of Machine Learning	4	4	1	-	-	5	50	50	100
Part III	**Core Course XII**	2566524	Data Handling and Visualization	4	4	1	-	-	5	50	50	100
Part III	**Core Practical VI**	2566527	Machine Learning Techniques Lab	2	-	1	4	-	5	50	50	100
Part III	**Core Practical VII**	2566528	Data Handling and Visualization Lab	2	-	1	4	-	5	50	50	100
Part III	**Discipline Specific Elective-DSE III – Employability Course**	2566525(A)/ 2566525(B)/ 2566525(C)	(A)Information and Cyber Security/ (B)Block Chain Technology/ (C)Deep Learning	3	4	1	-	-	5	50	50	100
Part III	**Multi-Disciplinary Elective – MDE I / Open Elective**	2566526(A)/ 2566526(B)/ 2566526(C)	(A) Online Commerce / (B) Digital Marketing/ (C)Supply Chain Management	3	4	1	-	-	5	50	50	100
Part III		2566529	Internship	2	-	-	-	-	-	-	-	-
Part IV			Value Education	2	-	-	-	-	-	50	50	100
Total				**22**	**16**	**6**	**8**		**30**	**350**	**350**	**700**

CIA-Continuous Internal Assessment
ESE-End Semester Examination

SCHEME OF VI SEMESTER B.Sc. DATA SCIENCE PROGRAMME
(For the students admitted from the academic year 2025-2026 and onwards)
Under Learning Objectives - Based Curriculum Framework & Choice Based Credit System

Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs. Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part III	**Core Course XIII**	2566630	Big Data Analytics with Hadoop and NoSQL Databases	4	4	1	-	-	5	50	50	100
Part III	**Core Course XIV**	2566631	IoT and Cloud Technologies with Security and Privacy Management	4	4	1	-	-	5	50	50	100
Part III	**Core Course XV**	2566632	Software Engineering	4	4	1	-	-	5	50	50	100
Part III	**Core Practical VIII**	2566633	Big Data Analytics Lab	2	-	1	3	-	4	50	50	100
Part III	**Core Practical IX**	2566634	IoT and Cloud Computing Lab	2	-	1	3	-	4	50	50	100
Part III	**Core Practical X**	2566635	Programming in UI Path Automation Lab	2	-	1	3	-	4	50	50	100
Part III	**Core Project**	2566636	Project Work	2	-	1	2	-	3	50	50	100
Part IV			Extension Activity	1	-	-	-	-	-	-	-	-
Total				**21**	**12**	**7**	**12**		**30**	**350**	**350**	**700**

CIA-Continuous Internal Assessment

ESE-End Semester Examination

Abstract of Scheme of Examination

(For the students admitted from the academic year 2025- 2026 and onwards)

S.No.	*Category*	*Course Category*	*No. of Courses*	*Credits*	*Total Credits*
1	**Part I**	**Language**	2	3	06
2	**Part II**	**English**	2	3	06
3	**Part III**	**Core Course (Theory)**	15	4	60
4		**Core Practical**	10	2	20
5		**Core Project**	1	2	2
6		**Generic Elective**	4	3	12
7		**Discipline Specific Elective**	3	3	9
8		**Multi-Disciplinary Elective**	1	3	3
1	**PART IV**	**Skill Enhancement Course – NME**	2	2	4
2		**Skill Enhancement Course – Discipline Specific**	2	2	4
3		**Soft Skills**	4	2	8
4		**Industrial Visit**	1	1	1
5		**EVS**	1	2	2
6		**Value Education**	1	2	2
7		**Internship**	1	2	2
8	**PART V**	**Extension Activity**	-	1	1
				Total Mandatory Credits	**142**
				Extra Credits (Maximum)	**21**
				Overall Credits	**163**

Extra Credits

Note: Students can take extra credit course from their own department or from other department as per the Admitting Body / University norms.

Self-Study course (2C) - (Department specific, curriculum and Evaluation scheme and assessment to be framed by the department

Value added course - minimum 30hrs **(2C)**

Certificate Course/Short-Time Course - minimum of 15 days (minimum 45 hrs) **(3C) -** preferred online

Swayam/NPTEL/MOOC courses (2C) - maximum of 12 credits

Skilled based vocational courses (2C) e.g. basic computing skills, tailoring, jewel making, beauty parlour course, interiors etc., through skill development cell of college.

Other languages (2C)
International HRD program – 30hrs **(2C)**

OVERALL CREDITS DISTRIBUTION

Component	Credits
Part I	6
Part II	6
Part III	106
Part IV	23
Part V	1
Total Mandatory Credits	142
Extra Credits (Maximum)	21
Overall Credits	163

Board of Studies Chairman **Academic Council -Member Secretary**

FIRST SEMESTER

Course Title: CORE I- OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code	**: 2566101**	**Credits**	**:04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *Understand the concepts of Object-Oriented Programming*
- *Become proficient programmers through the Java Programming language.*
- *Give insight into real world applications.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Use the syntax and semantics of java programming language and basic concepts of OOP.
CO2	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces, and packages
CO3	Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes.
CO4	Design event driven GUI and web related applications which mimic the real word scenarios
CO5	Build the internet-based dynamic applications using the concept of applets

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO/ PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction** Introduction to Java-Features of Java-Object Oriented Concepts-Software Evolution-Software Development, SDLC Models – SDLC steps – Software Testing – Software Quality – Lexical Issues-Data Types–Variables–Arrays–Operators- Control Statements–Classes–Objects –Constructors-Overloading method-Access control-static and fixed methods-Inner classes -Inheritance-Overriding Methods-Using super-Abstract class.	**12**	**CO1**
2	**MODULE II: Packages & Threads** Packages-Access Protection-Importing Packages -Interfaces-Exception Handling-Throw and Throws-Thread-Synchronization-Messaging-Runnable Interface-Inter thread communication - Deadlock-suspending, resuming, and stopping threads-Multithreading.	**12**	**CO2**
3	**MODULE III: Input/ Output &Collection API** I/O Streams-File Streams-String Objects-String Buffer-Char Array-Java Utilities-Collections interface-Collection classes- Enumeration– Vector-Stack –Hash tables - String class.	**12**	**CO3**
4	**MODULE IV**: Networking Networking–Networking basics–Java and the Net–Inet Address-TCP/IP Client Sockets– URL-URL Connection – TCP/IP Server Sockets–Datagrams.	**12**	**CO4**
5	**MODULE V: Graphical User Interface in Java** Working with windows using AWT Classes - Class Hierarchy of Window and Panel –AWT controls - Layout Managers – Menus- Menu bars - Dialog Boxes- File Dialog- Applets Lifecycle of Applet-Types of Applets-Event handling -Applet tags - JDBC and connecting to Databases– CRUD operations.	**12**	**CO5**

TEXT BOOKS:

1. Object-Oriented Programming with Java (2nd Edition) M. T. Somashekara, D. S. Guru, K. S. Manjunatha, 2nd Edition (2025) PHI Learning.
2. Java Language Features: With Modules, Streams, Threads, I/O, and Lambda Expressions (2nd Edition) Kishori Sharan, 2nd Edition (2018)

REFERENCE BOOKS:

1. Cays. Horstmann, Gary Cornell (2012), Core Java2 Volume I, Fundamentals-Ninth Edition Addison Wesley
2. K. Arnold and J. Gosling, The Java Programming Language-Second Edition, ACM Press/Addison-Wesley Publishing Co. New York

E-REFERENCES:

1. https://freecomputerbooks.com/Object-Oriented-Programming-in-Java-by-Rick-Halterman.html

FIRST SEMESTER

Course Title: CORE COURSE II- MODERN OPERATING SYSTEM

Course Code	**: 2566102**	**Credits**	**:04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To provide an in-depth understanding of client/server architecture and its advantages.*
- *To familiarize students with the components and development of client/server applications.*
- *To explore networking technologies, operating systems, software and hardware platforms.*
- *To evaluate performance, connectivity, and service strategies in client/server environments.*

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Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Comprehend the basic concepts of the client-server model. Improve the performance and reliability of Client-Server based systems.
CO2	Components of Client-Server Applications and Role. Understand how Client-Server systems work.
CO3	Understand the Connectivity. Comprehend the concept of different technologies.
CO4	Understand the software and hardware requirements of Client-Server based systems. Improve the common interface across platforms.
CO5	Understand the service and support of the system. Identify security and ethical issues in Client Server Computing.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	Contents of Module	Hrs.	COs
1	**MODULE I**: **Introduction to Operating Systems** What is an Operating System? Types of Operating Systems (Batch, Time Sharing, Distributed, Real-Time, Mobile),OS Structure: Monolithic, Layered, Microkernel, Modular ,System Calls and OS Services, Operating System Architectures	**12**	**CO1**
2	**MODULE II: Process Management** Concept of Process and Process Lifecycle, Threads and Multithreading, CPU Scheduling: FCFS, SJF, Round Robin, Priority Scheduling, Multilevel Queues, Context Switching, Inter process Communication (IPC)	**12**	**CO2**
3	**MODULE III: Synchronization & Deadlocks** Race Conditions and Critical Section, Synchronization Tools: Semaphores, Monitors, Mutex, Classical Problems of Synchronization (Producer-Consumer, Dining Philosophers),Deadlocks: Conditions, Detection, Prevention, Avoidance (Banker's Algorithm),Recovery from Deadlock	**12**	**CO3**
4	**MODULE IV**: **Memory Management** Logical vs Physical Address Space, Contiguous Memory Allocation, Paging, Segmentation, Virtual Memory: Demand Paging, Page Replacement Algorithms (FIFO, LRU, Optimal),Thrashing and Working Set Model	12	**CO4**
5	**MODULE V: File Systems and Storage Management** File Concepts and Access Methods, Directory Structures, File Allocation Techniques (Contiguous, Linked, Indexed),Disk Scheduling Algorithms (FCFS, SSTF, SCAN, C-SCAN),File System Implementation and Free-Space Management	**12**	**CO5**

TEXT BOOKS:

1. Modern Operating Systems by **Andrew S. Tanenbaum & Herbert**
2. Operating Systems: Internals and Design Principles by **William Stallings**

REFERENCE BOOKS:

1. Operating System Concepts by **Abraham Silberschatz, Greg Gagne, and Peter B. Galvin**Alex Berson; Client/Server Architecture, McGraw-Hill
2. Operating Systems: Three Easy Pieces by **Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau**

E-REFERENCES:

1. https://freecomputerbooks.com/Modern-Operating-Systems-by-Andrew-Tanenbaum.html

FISRST SEMESTER

Course Title: CORE PRACTICAL I- OBJECT ORIENTED PROGRAMMING USING JAVA LAB

Course Code : 2566103	**Credits :02**
L:T:P:S : 0:1:3:0	**CIA Marks :50**
Exam Hours : 03	**ESE Marks :100**

Learning Objectives:

- *Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.*
- *Read and make elementary modifications to Java programs that solve real-world problems.*

Course Outcome: At the end students will be able to

CO1	Create Java programs using object-oriented programming concepts.
CO2	Apply packages, interfaces, exception handling, and multithreading.
CO3	Utilize string handling and collection classes.
CO4	Implement file operations for data handling.
CO5	Develop GUI applications using AWT, applets, and networking.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	2	3	3	2	3	3	2	3	3	3	2	2
CO3	3	3	2	2	3	3	3	2	3	2	2	3
CO4	3	3	3	2	3	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**Object-Oriented Programming Concepts in Java** a. Constructors b. Inheritance c. Overloading and overriding	**9**	**CO1**
2	**Advanced Java Features** a. Packages, interfaces, Exception handling b. Concurrent and synchronized threads	**9**	**CO2**
3	**Working with Core Java Classes and Data Structures** a. String and String Buffer classes and methods b. Stack and Vector	9	**CO3**
4	**File Handling in Java** a. Implementation of file read and write operation	**9**	**CO4**
5	**Graphical User Interface and Network Programming** a. Frames and various controls b. Dialogs and Menus c. Panel and Layout d. Incorporating Graphics e. Applets f. Working with Images g. Network Programming	**9**	**CO5**

REFERENCE BOOKS :

1. **Cay S. Horstmann, Gary Cornell (2012),** *Core Java Volume I – Fundamentals*, Ninth Edition, Addison Wesley.
2. **Herbert Schildt (2018),** *Java: The Complete Reference*, Eleventh Edition, McGraw-Hill Education.
3. **Paul Deitel, Harvey Deitel (2017),** *Java How to Program*, Eleventh Edition, Pearson Education.

FIRST SEMESTER

SKILL ENHANCEMENT COURSE – DISCIPLINE SPECIFIC –I-THEORY

Course Title: SEC- DSE- I - ADVANCED EXCEL

Course Code	**: 2566104**	**Credits**	**02**
L:T:P:S	**: 2:0:0:0**	**CIA Marks**	**50**
Exam Hours	**: 03**	**ESE Marks**	**100**

Learning Objectives:

- *To provide foundational and advanced knowledge of Microsoft Excel functionalities.*
- *To enable students to perform data analysis, data visualization, and automation using Excel.*
- *To familiarize students with Excel tools relevant for statistical and data-driven decision making.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the Excel interface, worksheet elements, and data management techniques. Apply formatting, referencing, and validation techniques for organized data.
CO2	Apply logical, statistical, lookup, and text functions to compute complex data. Develop problem-solving strategies using Excel formulas.
CO3	Create professional data visualizations using charts, pivot tables, and dashboards. Analyze trends and patterns using Excel visualization tools.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	1	1	3	2	2	3	2	2
CO2	3	2	2	1	2	1	3	2	2	3	2	2
CO3	3	2	3	1	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S. No.	Contents of Module	Hrs.	COs
1	**MODULE I: Excel Basics & Data Management** Interface and Navigation, Cell Referencing (Relative, Absolute, Mixed); Data Entry and Formatting; Sorting, Filtering, and Conditional Formatting; Data Validation and Drop-down Lists; Named Ranges	**10**	**CO1**
2	**MODULE II: Functions and Formulas** Logical Functions: IF, AND, OR, IFERROR; Lookup Functions: VLOOKUP, HLOOKUP, XLOOKUP (latest versions), INDEX & MATCH; Text Functions: LEFT, RIGHT, MID, CONCATENATE, TEXT SPLIT; Date & Time Functions; Statistical Functions: AVERAGE, MEDIAN, MODE, STDEV, COUNTIF(S), SUMIF(S)	**10**	**CO2**
3	**MODULE III: Charts and Data Visualization** Creating Charts: Column, Line, Pie, Bar, Area, Combo Charts; Using Sparkline's; Chart Formatting and Design; Pivot Tables & Pivot Charts; Slicers and Timeline for Dynamic Analysis	**10**	**CO3**

TEXT BOOKS:

1. **Prof. Sham Tickoo**;*Title*: "Learning Microsoft Excel 2021 – A Step by Step Guide" *Edition*: 2021
2. **Curtis D. Frye**;*Title*: *Microsoft Excel 2021 Step by Step*;*Edition*: Microsoft Press, 1st Edition,(2022)

REFERENCE BOOKS:

1. **John Walkenbach**;*Title*: *Excel 2019 Bible*; Wiley, 1st Edition
2. **Michael Alexander & Dick Kusleika**;*Title*: *Excel 2021 Formulas and Functions*; Wiley, 1st Edition (2022)

E-REFERENCES:

1. https://alison.com/course/advanced-excel-2021
2. https://trumpexcel.com/learn-excel/

FIRST SEMESTER

SKILL ENHANCEMENT COURSE-NON-MAJOR ELECTIVE-I

Course Title: SEC-NME-I – PROGRAMMING CONCEPTS AND TECHNIQUES

Course Code	**: 2566105**	**Credits**	**02**
L:T:P:S	**: 2:0:0:0**	**CIA Marks**	**50**
Exam Hours	**: 1:30 Hours**	**ESE Marks**	**50**

Learning Objectives:

- *To express algorithms and draw flowcharts in a language independent manner.*
- *To teach how to write modular, efficient and readable C programs.*
- *To impart knowledge in creating and using Arrays of the C datatypes.*
- *To describe the techniques for creating program modules in creating using functions and recursive functions.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate knowledge of basic programming concepts such as variables, data types, operators, and expressions.
CO2	Break down complex problems into smaller, manageable tasks using logical thinking.
CO3	Develop algorithms to solve simple computational problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	1	1	3	2	2	3	2	2
CO2	3	2	2	1	2	1	3	2	2	3	2	2
CO3	3	2	3	1	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE-I** Introduction to the C Language– Algorithm, Pseudocode, Flowchart, Background, C Programs, Identifiers, Datatypes, Variables, Constants, Input/Output, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associatively, Expression Evaluation, Type conversions.	**10**	**CO1**
2	**MODULE-II** Statements- Selection Statements (making decisions) – if and switch statements, Repetition statements(loops)-while, for, do-while statements, Loop examples, other statements related to looping– break, continue, go to, Simple C Program examples.	**10**	**CO2**
3	**MODULE-III** Functions-Introduction to Structured Programming, Functions-basics, user defined functions, inter function communication (call by value, call by reference), Standard functions. Storage classes-auto, register, static, extern, scope rules, arrays to functions, recursive functions, example C programs.	**10**	**CO3**

TEXT BOOKS:

1. Computer Science: A Structured Programming Approach Using C,B.A.Forouzan and R.F.Gilberg, Third Edition, Cengage Learning.
2. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd edition

REFERENCE BOOKS:

1. Let Us C Yashavantkanetkar BPB.
2. Absolute beginner's guide to C, Greg M. Perry, Edition2, Publisher: SamsPub.,1994.
3. Computer Programming and Data Structures by E Balagurusamy, Tata McGraw Hill

E-REFERENCES:

1. https://cs50.harvard.edu/x/
2. https://www.coursera.org/learn/intro-programming

SECOND SEMESTER

Course Title: CORE COURSE III –DATA STRUCTURES AND ANALYSIS OF ALGORITHMS

Course Code	**: 2566206**	**Credits**	**: 04**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Understand asymptotic analysis and its application in evaluating algorithm performance*
- *Enhance problem-solving and logical thinking through algorithm design.*
- *Implement efficient data structures and algorithms using a high-level programming language.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand asymptotic notations and analyze the time and space complexity of algorithms.
CO2	Understand the structure and applications of trees and graphs.
CO3	Apply searching and sorting algorithms for problem-solving.
CO4	Analyze and implement algorithms using the Greedy method.
CO5	Design and solve problems using the Backtracking technique.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	1	1	1	3	2	1	1	1	2
CO2	3	2	3	1	1	1	3	3	1	1	1	3
CO3	3	3	3	1	2	2	3	3	2	2	2	3
CO4	3	3	3	1	1	2	3	3	2	1	1	3
CO5	3	3	3	1	1	2	3	3	2	1	1	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Arrays and ordered Lists** Abstract data types – asymptotic notations – complexity analysis- Linked lists: Singly linked list – doubly linked lists - Circular linked list, General lists- stacks – Queues – Circular Queues – Evaluation of expressions.	**12**	**CO1**
2	**MODULE II: Trees and Graphs** Trees – Binary Trees – Binary Tree Traversal – Binary Tree Representations – Binary Search Trees - threaded Binary Trees - Application of trees (Sets). Representation of Graphs – Graph implementation – graph Traversals - Minimum Cost Spanning Trees – Shortest Path Problems	**12**	**CO2**
3	**MODULE III: Searching and Sorting** Sorting – Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Selection Sort. Searching – Linear search, Binary search.	**12**	**CO3**
4	**MODULE IV: Greedy Method and Dynamic programming** Greedy Method: Knapsack problem– Job Sequencing with deadlines – Optimal storage on tapes. General method – Multistage Graph Forward Method– All pairs shortest path – Single source shortest path – Search Techniques for Graphs – DFS – Connected Components – Bi-Connected Components	**12**	**CO4**
5	**MODULE V: Backtracking** General Method – 8-Queen‟s – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Branch and Bound: General Method – Travelling Salesperson Problem	**12**	**CO5**

TEXT BOOKS:

1. **Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed**, *Fundamentals of Data Structures in C*, 2nd Edition (Reprint), Universities Press, **2022**.
2. **Mark Allen Weiss**, *Data Structures and Algorithm Analysis in C*, 4th Edition, Pearson Education, **2023**.

REFERENCE BOOKS:

1. **Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein**, *Introduction to Algorithms*, 4th Edition, MIT Press, **2022**
2. **Narasimha Karumanchi**, *Data Structures and Algorithms Made Easy*, 6th Edition, CareerMonk Publications, **2023**.

E-REFERENCES:

1. https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-fall-2011/
2. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
3. https://www.geeksforgeeks.org/data-structures/

SECOND SEMESTER

Course Title: CORE COURSE IV- PYTHON FOR DATA SCIENCE

Course Code	**: 2566207**	**Credits**	**04**
L: T: P:S	**: 3:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To introduce Python programming for data analysis and scientific computing.*
- *To explore popular Python libraries for data wrangling, visualization, and statistical analysis.*
- *To build foundational skills in machine learning and model evaluation using Python.*
- *To apply data preprocessing techniques for real-world datasets.*

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

CO1	Demonstrate a strong understanding of Python programming basics, including data types, control structures, functions, and debugging techniques
CO2	Apply Python libraries like NumPy, Pandas, and visualization tools (Matplotlib, Seaborn) for data manipulation, cleaning, and exploratory data analysis.
CO3	Implement data preprocessing techniques, handle missing data, perform statistical analysis, and apply dimensionality reduction methods for feature engineering.
CO4	Build and evaluate machine learning models using Scikit-learn for supervised and unsupervised learning, and optimize models with cross-validation and hyper parameter tuning.
CO5	Design and develop applications using advanced Python topics such as NLP, deep learning with TensorFlow, and big data processing with PySpark, along with hands-on projects like sentiment analysis and recommender systems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	1	2	1	3	3	2	3	2	2
CO2	3	3	3	1	2	1	3	3	2	3	2	2
CO3	3	3	3	1	2	2	3	3	3	3	3	2
CO4	3	3	3	2	2	2	3	3	3	3	3	2
CO5	3	3	3	2	2	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I - Python Programming Fundamentals** Introduction to Python: Features and Applications; Python IDEs: Jupiter, Anaconda, VS Code; Variables, Data Types, and Operators; Control Structures: if-else, loops; Functions and Modules; File Handling Basics; Exception Handling and Debugging.	**12**	**CO1**
2	**MODULE II - Essential Python Libraries for Data Science** NumPy: Arrays, Indexing, Array Operations; Pandas: Series, Data Frames, Data Cleaning; Aggregation, Grouping, and Merging; Data Visualization: Matplotlib Basics. Seaborn for Statistical Visuals.	**12**	**CO2**
3	**MODULE III – Data Preprocessing and EDA** Handling Missing Data; Data Transformation and Scaling; Outlier Detection Techniques; Exploratory Data Analysis (EDA); Introduction to Time-Series Data	**12**	**CO3**
4	**MODULE IV – Introduction to Machine Learning** Scikit-learn Basics; Supervised Learning: Linear Regression, Logistic Regression, Decision Trees; Model Evaluation: Accuracy, Confusion Matrix, Precision, Recall, F1-Score.	**12**	**CO4**
5	**MODULE V – Unsupervised Learning and Applied Topics** Unsupervised Learning: K-Means Clustering, Hierarchical Clustering; Introduction to Natural Language Processing (NLP): Tokenization, Stop Words; Basics of Neural Networks using Kera's	**12**	**CO5**

TEXT BOOKS:

1. Reema Thareja – *Python Programming: Using Problem Solving Approach*, Oxford University Press, 2nd Edition, 2023.
2. Jake VanderPlas – *Python Data Science Handbook*, O'Reilly Media, 2nd Edition, 2022.

REFERENCE BOOKS:

1. Wes McKinney – *Python for Data Analysis*, O'Reilly, 3rd Edition, 2022.
2. Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly, 3rd Edition, 2022.

E-REFERENCES:

1. https://www.geeksforgeeks.org/python-data-science-tutorials/
2. https://www.kaggle.com/learn/python

SECOND SEMESTER

Course Title: CORE PRACTICAL II- PYTHON FOR DATA SCIENCE LAB

Course Code	**: 2566208**	**Credits**	**: 02**
L: T: P: S	**: 0:1:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To build a strong foundation in Python programming and gain proficiency in basic syntax, data structures, and control flow.*
- *To introduce students to essential Python libraries like NumPy, Pandas, and Matplotlib for data manipulation, analysis, and visualization.*
- *To apply Python programming to solve real-world problems, including working with numbers, strings, and data structures, as well as handling user input.*
- *To ensure students gain practical experience by writing Python programs to execute various tasks such as file handling, string manipulation, and performing basic mathematical operations.*

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

CO1	Write Python programs using variables, data types, operators, and control flow statements for basic problem solving.
CO2	Develop and apply functions to implement mathematical and logical solutions.
CO3	Manipulate and manage data structures such as lists and dictionaries effectively.
CO4	Perform file input and output operations for data persistence.
CO5	Create basic visual representations of data using Python libraries like Matplotlib.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	1	2	1	3	3	2	3	2	2
CO2	3	3	3	1	2	1	3	3	2	3	2	2
CO3	3	3	3	1	2	2	3	3	3	3	3	2
CO4	3	3	3	2	2	2	3	3	3	3	3	2
CO5	3	3	3	2	2	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs	COs
1	**Fundamentals of Python Programming** • Variables, • Data Types, • Basic Operators, • Arithmetic Operations, • Control Statements (if-else, loops)	**9**	**CO1**
2	**Functions and Modular Programming in Python** • Defining Functions, • Parameters and Return Values, • Writing Modular Code, • GCD Calculation Function	**9**	**CO2**
3	**Working with Data Structures and Strings** • Lists: o Adding, Removing, • Max/Min Operations; • Dictionaries: o Create and Manipulate; String Operations (concatenation, case conversion, reversing)	**9**	**CO3**
4	**File Handling and Exception Management** • File Creation, • Writing to Files, • Reading from Files, • Exception Handling in File Operations	**9**	**CO4**
5	**Data Visualization with Matplotlib** • Basics of Matplotlib, • Plotting Simple Line Graphs, • Customizing Plots	**9**	**CO5**

REFERENCE BOOKS:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, Green Tea Press, 2015.
2. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media, 2013.
3. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, 2016.

SECOND SEMESTER

SKILL ENHANCEMENT COURSE – DISCIPLINE SPECIFIC -II

Course Title: DSE- II–INTERACTIVE DATA VISUALIZATION

Course Code	**: 2566209**	**Credits**	**: 02**
L: T:P:S	**: 2:0:0:0**	**CIA Marks**	**50**
Exam Hours	**: 03**	**ESE Marks**	**100**

Learning Objectives:

- *To introduce the principles and tools for visualizing data interactively.*
- *To enable students to create insightful dashboards and visual narratives.*
- *To develop skills in using libraries such as Plotly, Dash, and Tableau for interactive visualization.*
- *To foster an understanding of how to present data effectively for analysis and communication.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the fundamental principles and types of data visualization.
CO2	Use Python libraries (Plotly and Dash) to create interactive visualizations
CO3	Create, filter, and publish dashboards using Tableau.
CO4	Design visually compelling and interactive dashboards for real-time data analysis.
CO5	Apply best practices and ethical considerations in data storytelling and visual design.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	3	1	2	2	2	2	2	2
CO2	3	3	3	1	2	1	3	3	3	3	2	3
CO3	3	3	3	1	2	1	3	3	3	3	3	3
CO4	3	3	3	2	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S. No.	Contents of Module	Hrs.	COs
1	**MODULE I – Fundamentals of Data Visualization** Importance and Goals of Data Visualization; Types of Data and Charts; Principles of Visual Design: Clarity, Efficiency, Aesthetics; Exploratory vs Explanatory Visualizations	6	CO1
2	**MODULE II – Data Visualization with Python Libraries** Introduction to Polly: Scatter, Line, Bar, Pie Charts; Interactive Charts: Tooltips, Hover Effects, Legends; Introduction to Dash: App Layouts, Callbacks, Interactivity; Creating Simple Dashboards using Dash	6	CO2
3	**MODULE III – Data Visualization with Tableau** Tableau Interface Overview; Importing and Cleaning Data; Creating Visuals: Bar, Line, Maps, Tables; Filters, Parameters, and Dashboards; Publishing and Sharing Insights	6	CO3
4	**MODULE IV – Visual Storytelling and Dashboards** Building Effective Dashboards; Design Considerations and Best Practices; Use Cases: Business, Healthcare, Education; Embedding Dashboards and Sharing Online	6	CO4
5	**MODULE V – Case Studies and Projects** Mini Projects with Real-World Datasets; Case Studies using Tableau Public and Dash; Collaborative Visualization: Hosting and Presentation; Ethics in Data Visualization: Misleading Visuals, Accessibility	6	CO5

TEXT BOOKS:

1. **Kirk, Andy** – *Data Visualization: A Handbook for Data Driven Design*, Sage Publications, 2nd Edition, 2019.
2. **Deeplearning.ai Team** – *Data Visualization with Python*, Coursera & Pearson, 2022

REFERENCE BOOKS:

1. **Jonathan Schwabish** – *Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks*, Columbia University Press, 1st Edition, 2021.
2. **Ben Jones** – *Learning Tableau 2022*, Packt Publishing, 5th Edition, 2022.

E-REFERENCES:

1. https://plotly.com/python/
2. https://www.tableau.com/learn/training

SECOND SEMESTER

SKILL ENHANCEMENT COURSE -NON-MAJOR ELECTIVE-II

Course Title: NME-II – PRINCIPLES OF OPEN SOURCE SOFTWARE DEVELOPMENT

Course Code : 2566210	**Credits 02**
L: T: P:S : 2:0:0:0	**CIA Marks : 50**
Exam Hours : 1:30 Hours	**ESE Marks : 50**

Learning Objectives:

- *Understand the fundamentals and philosophy of Free and Open Source Software (FOSS).*
- *Compare proprietary software with FOSS in terms of licensing, distribution, and usage.*
- *Gain hands-on experience with open-source technologies such as Linux, MySQL, PHP, Python, and Perl.To understand open source software practices and tools.*
- *Apply open-source principles in real-time programming and web-based applications.*
- *Understand legal and ethical implications of using and contributing to FOSS.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Define and explain the key concepts and philosophy of Free and Open-Source Software.
CO2	Differentiate between proprietary software and FOSS with respect to licensing and usage.
CO3	Understand different types of licenses (GPL, MIT, Apache, etc.) and their implications for software usage and distribution.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO6
CO1	2	2	2	1	3	1	2	2	2	2	2	2
CO2	3	3	3	1	2	1	3	3	3	3	2	3
CO3	3	3	3	2	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl.No.	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Open Source & Linux** Introduction to open sources–Need of open sources–advantages of open sources–application of open sources. Open-source operating systems: LINUX: Introduction–general overview– Kernel mode and user mode– process–advanced concepts–scheduling–personalities–cloning– signals– development with Linux.	**10**	**CO1**
2	**MODULE II: Introduction to MySQL** MySQL: Introduction – setting up account – starting, terminating, and writing your own SQL programs-record selection Technology–working with strings–Date and Time–sorting Query results–generating summary –working with meta data–using sequences–MySQL and Web.	**10**	**CO2**
3	**MODULE III: PHP Programming and SQL Integration** PHP: Introduction–programminginwebenvironment–variables-constants–datatypes–operators – statements – functions – arrays – OOP – string manipulations and regular expression –file handling and data storage – PHP and SQL database – PHP and LDAP – PHP connectivity – sending and receiving E-mails–debugging and error handling–security –templates.	**10**	**CO3**

TEXT BOOKS:

1. **Vikram Vaswani**, *MySQL: The Complete Reference*, 2nd Edition, McGraw-Hill, **2020**.
2. **Steve Holzner**, *PHP: The Complete Reference*, 2nd Edition, McGraw-Hill, **2019**.
3. **Martin C. Brown**, *Perl: The Complete Reference*, 2nd Edition, McGraw-Hill, **2009**.
4. **Rasmus Lerdorf & Kevin Tatroe**, *Programming PHP*, O'Reilly Media, **2022**.

REFERENCE BOOKS:

1. Programming PHP, RasmusLerdorfandLevinTatroe, O_Reilly,2002
2. Perl: The Complete Reference, 2nd Edition, MartinC.Brown, TMH,2009
3. MySQL: The Complete Reference, 2nd Edition, Vikram Vaswani, TMH,2009
4. PHP: TheCompleteReference,2nd Edition, Steve Holzner, TMH,2009.

E-REFERENCES:

1. https://training.linuxfoundation.org
2. https://opensource.guide/how-to-contribute/

THIRD SEMESTER

Course Title: CORE COURSE V –WEB DESIGN AND DEVELOPMENT

Course Code	**: 2566311**	**Credits**	**4**
L: T:P:S	**: 4:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**100**

Learning Objectives:

- *To develop the skill & knowledge of Web page design.*
- *Develop semantic and well-structured HTML documents. Style web pages using CSS for layout, typography, color, and responsiveness.*
- *Students will understand to know how and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Define the principle of web page design and define the basics in web design.
CO2	Visualize the basic concept of HTML.
CO3	Recognize the elements of HTML.
CO4	Introduce basics concept of CSS.
CO5	Develop the concept of web publishing.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	2	1	2	2	1	1	1	2
CO2	2	1	2	1	1	1	2	3	1	2	1	3
CO3	2	1	3	1	2	1	3	3	2	2	1	3
CO4	2	1	3	1	2	1	3	3	2	3	1	3
CO5	2	2	3	2	3	2	3	3	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S. No.	Contents of Module	Hrs.	COs
1	**MODULE I: Web Design Principles and Basics in Web Design** Basic principles involved in developing a web site - Planning process - Five Golden rules of web designing - Designing navigation bar - Page design - Home Page Layout - Design Concept. Brief History of Internet - What is World Wide Web - Why create a web site - Web Standards - Audience requirement.	**15**	**CO1**
2	**MODULE II: Introduction to HTML** What is HTML - HTML Documents - Basic structure of an HTML document - Creating an HTML document - Mark up Tags - Heading-Paragraphs - Line Breaks - HTML Tags?	**15**	**CO2**
3	**MODULE III: Elements of HTML** Introduction to elements of HTML - Working with Text - Working with Lists, Tables and Frames - Working with Hyperlinks, Images and Multimedia - Working with Forms and controls.	**15**	**CO3**
4	**MODULE IV: Introduction to Cascading Style Sheets** Concept of CSS - Creating Style Sheet - CSS Properties - CSS Styling (Background, Text Format, Controlling Fonts) - Working with block elements and objects - Working with Lists and Tables - CSS Id and Class - Box Model (Introduction, Border properties, Padding Properties, Margin properties) - CSS Color - Creating Page Layout and Site Designs.	**15**	**CO4**
5	**MODULE V: Introduction to Web Publishing or Hosting** Creating the Web Site - Saving the site - Working on the web site - Creating web site structure - Creating Titles for web pages - Themes-Publishing web sites.	**15**	**CO5**

TEXT BOOKS:

1. Kogent Learning Solutions Inc., HTML 5 in simple steps, Dreamtech Press.
2. Web Design with HTML & CSS: HTML & CSS Complete Beginner's Guide, Prem Kumar.
3. MASTERING HTML, CSS & Java Script Web Publishing Paperback – 15 July 2016 By Laura Lemay.

REFERENCE BOOKS:

1. Steven M. Schafer, HTML, XHTML, and CSS Bible, 5ed, Wiley India.
2. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India.
3. Ian Pouncey, Richard York, and Beginning CSS: Cascading Style Sheets for Web Design, Wiley India.
4. Kogent Learning, Web Technologies: HTML, Javascript, Wiley India.

E - REFERENCES:

1. https://developer.mozilla.org/
2. https://css-tricks.com/
3. https://www.smashingmagazine.com/

THIRD SEMESTER

Course Title: **CORE COURSE VI – FUNDAMENTALS OF DATA ENGINEERING**

Course Code : 2566312		**Credits**	**04**
L: T:P:S : 4:1:0:0		**CIA Marks**	**50**
Exam Hours : 03		**ESE Marks**	**100**

Learning Objectives:

- *To understand the fundamental concepts of data engineering, including data management, data modeling, and the architecture of modern data systems.*
- *To equip students with skills in data ingestion, transformation, and storage using modern tools and techniques.*
- *To explore data warehousing concepts, ETL processes, and big data platforms for large-scale data processing and storage.*
- *To design, develop, and optimize data pipelines for real-time and batch data processing.*
- *To apply data engineering concepts in real-world scenarios, addressing scalability, security, and performance challenges.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe the principles and key technologies of data engineering, including data architecture and modeling.
CO2	Develop scalable data integration and ETL processes for structured and unstructured data.
CO3	Implement data warehousing solutions and process big data using Hadoop, Spark, and other modern tools.
CO4	Create efficient, fault-tolerant data pipelines for batch and real-time data processing.
CO5	Apply data engineering solutions to real-world challenges, including handling big data and ensuring data quality, security, and availability

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	2	1	1	3	2	2	1	1	2
CO2	3	3	3	2	2	1	3	3	2	2	2	3
CO3	3	3	3	2	2	2	3	3	3	3	2	3
CO4	3	3	3	2	3	2	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Data Engineering** Overview of Data Engineering-Data Life Cycle: Ingestion, Processing, Storage, and Consumption-Data Architecture and Modern Data Systems-Structured vs. Unstructured Data-Introduction to Relational Databases (SQL) and NoSQL Databases-Introduction to Data Modeling: ER Diagrams, Star Schema, and Snowflake Schema.	**15**	**CO1**
2	**MODULE II: Data Integration and ETL** Data Integration Techniques and Challenges-Extract, Transform, Load (ETL) Processes-Tools for Data Integration: Apache Nifi,Talend, Informatica-Data Cleaning and Transformation Techniques-Introduction to APIs for Data Access.	**15**	**CO2**
3	**MODULE III: Data Warehousing and Big Data Platforms** Concepts of Data Warehousing Building a Data Warehouse: Fact and Dimension Tables-OLAP vs. OLTP-Introduction to Hadoop Ecosystem: HDFS, MapReduce-Big Data Processing with Apache Spark-Distributed Data Storage: Cassandra, HBase.	**15**	**CO3**
4	**MODULE IV: Data Pipelines and Workflow Management** Design Principles for Data Pipelines-Batch Processing vs. Real-Time Processing-Orchestration Tools: Apache Airflow, Luigi-Monitoring and Debugging Data Pipelines-Optimizing Data Pipelines for Scalability and Performance-Introduction to Cloud-Based Data Engineering Tools (AWS, GCP, and Azure).	**15**	**CO4**
5	**MODULE V: Advanced Topics and Applications:** Data Governance and Security: GDPR, Data Privacy-Ensuring Data Quality: Profiling and Validation-Working with Semi-Structured Data (JSON, XML)-Introduction to Grap Databases (Neo4j)-Case Studies: Building Data Pipelines for E-Commerce, IoT, and social media.	**15**	**CO5**

TEXTBOOKS:

1. Data Engineering Fundamentals, Zhaolong Liu
2. Data Engineering And Data Science Concepts And Applications, John wiley & Sons Inc
3. Data Engineering Concepts: From Basics To Advance Techniques (Book, Dr. RVS Praveen)

REFERENCE BOOKS:

1. Jules S. Damji et al., "Learning Spark: Lightning-Fast Data Analytics," O'Reilly Media, 2020.
2. Joe Reis and Matt Housley, "Fundamentals of Data Engineering," O'Reilly Media, 2022.
3. Mark Grover et al., "Designing Data-Intensive Applications," O'Reilly Media, 2016.

E - REFERENCES:

1. https://towardsdatascience.com/tagged/data-engineering
2. https://airflow.apache.org/docs/

THIRD SEMESTER

Course Title: **CORE COURSE VII – PRINCIPLES OF DATA MINING**

Course Code : 2566313	**Credits 4**
L:T:P:S : 4:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To understand data mining concepts.*
- *To learn Data mining techniques and algorithms.*
- *Comprehend the data mining environments.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Compare various conceptions of data mining as evidenced in both research and application.
CO2	Characterize the various kinds of patterns that can be discovered by association rule mining. Understand and apply various clustering paradigms. Analyze and implement hierarchical clustering techniques
CO3	Investigate approximate methods and integration of pruning and construction in decision tree algorithms
CO4	Understand text mining concepts, including unstructured text processing and text clustering, for analyzing textual data.
CO5	Compare various conceptions of data mining as evidenced in both research and application.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	1	3	2	3	1	2	2
CO2	3	3	3	2	2	1	3	3	3	2	2	3
CO3	3	3	3	2	2	1	3	3	3	2	2	3
CO4	3	2	2	2	2	1	3	3	3	2	2	3
CO5	3	2	2	2	2	1	3	2	3	1	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Data Mining** What is Data Mining? Data Mining: Definitions, KDD vs Data Mining, DBMS vs DM, Other Related Areas, DM Techniques, Other Mining Techniques, Issues and Challenges in DM, DM Applications- Case Studies. Data Preprocessing, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.	**15**	**CO1**
2	**MODULE II: Association Rules** What is an Association Rule?, Methods to Discover Association Rules, A Priori Algorithm, Partition Algorithm, Pincer-Search Algorithm, Dynamic Itemset Counting Algorithms, FP-Tree Growth Algorithm, Discussion on Different Algorithms, Incremental Algorithms, Border Algorithms, Generalized Association Rule, Association Rules with Item Constraints.	**15**	**CO2**
3	**MODULE III: Clustering Techniques** Clustering Paradigms, Partitioning Algorithms, k-Medoid Algorithms, CLARA, CLARANS, Hierarchical Clustering, DBSCAN, BIRCH, CURE, Categorical Clustering Algorithms, STIRR, ROCK, CACTUS.	**15**	**CO3**
4	**MODULE V: Decision Trees** What is a Decision Tree? Tree Construction Principle, Best Split, Splitting Indices, Splitting Criteria, Decision Tree Construction Algorithms, CART, ID3, C4.5, Decision Tree Construction with Presorting, Rain Forest, Approximate Methods, CLOUDS, BOAT, Pruning Techniques, Integration of Pruning and Construction, Ideal Algorithm.	**15**	**CO4**
5	**MODULE V: Other Techniques** What is a Neural Network? Learning in NN, Unsupervised Leaning, Data Mining Using NN: A Case Study, Genetic Algorithms, Rough Sets, Support Vector Machines. **Web Mining:** Web Mining, Web Content Mining, Web Structure Mining, Web Usage Mining, Text Mining, Unstructured Text, Episode Rule Discovery for Texts, Hierarchy of Categories, Text Clustering	**15**	**CO5**

TEXT BOOKS:

1. Data Mining Techniques, Arun K Pujari, University Press
2. Data Mining: Concepts and Techniques, 3rd Edition, Jiawei Han, Micheline Kamber, Jian Pei.

REFERENCE BOOKS:

1. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India.
2. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2010.

E - REFERENCES:

1. https://www.kdnuggets.com/
2. https://developer.ibm.com/articles/data-mining-introduction/
3. http://web.stanford.edu/class/cs345a/

THIRD SEMESTER

Course Title: CORE PRACTICAL III- DATA MINING LAB

Course Code : 2566315	**Credits 02**
L: T: P: S : 0:1:3:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *Learn techniques for cleaning, transforming, and normalizing data.*
- *Handle missing or noisy data and explore data quality issues.*
- *Implement and experiment with popular algorithms like decision trees, k-means, Neural networks and Apriori.*

Course outcome: the end of course, the student will be able to

CO1	Demonstrate the creation of data sets and perform data preprocessing by applying data cleaning techniques. Generate association rules using the Apriori algorithm.
CO2	Apply data mining techniques for pattern discovery and classification through hands-on implementation of association rule mining and decision tree-based learning methods.
CO3	Apply and evaluate different classifiers for effective data analysis and decision-making.
CO4	Apply clustering techniques by constructing distance matrices and implement various clustering algorithms for discovering data patterns and groupings in datasets.
CO5	Analyze anomalies and outliers in datasets using clustering and density-based detection techniques for effective data analysis and pattern recognition.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	1	3	2	3	1	2	2
CO2	3	3	3	2	2	1	3	3	3	2	2	3
CO3	3	3	3	2	2	1	3	3	3	2	2	3
CO4	3	2	2	2	2	1	3	3	3	2	2	3
CO5	3	2	2	2	2	1	3	2	3	1	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	• Basics of WEKA tool a) Investigate the Application interfaces. b) Explore the default datasets. • Pre-process a given dataset based on the following: a) Attribute Selection b) Handling Missing Values c) Discretization d) Eliminating Outliers.	9	**CO1**
2	**Implementation of Data Mining Algorithms** a) Generate Association Rules using the FP-Growth algorithm. b) Build a Decision Tree using ID3 algorithm.	9	**CO2**
3	**Classification Techniques** a) using Naïve Bayesian Classifier. b) using Rule based Classifier. c) using nearest neighbor Classifier.	9	**CO3**
4	**Clustering and Distance-Based Analysis** a) using various distance measures. b) using the k-Means algorithm c) using clustering algorithm. d) using the DBSCAN algorithm.	9	**CO4**
5	**Anomaly and Outlier Detection** a) Detect anomalies using any clustering algorithm. b) Implement density-based outlier detection.	9	**CO5**

REFERENCE BOOKS :

1. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, Publisher: Morgan Kaufmann.
2. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Jian Pei

THIRD SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-I- EMPLOYABILITY COURSE

Course Title: **DSE-I (A) COMPUTER NETWORKS**

Course Code	**: 2566314(A)**	**Credits**	**03**
L:T:P:S	**: 3:1:0:0**	**CIA Marks**	**50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *To introduce the fundamental network architecture concepts and their core principle issues in the emerging communication / data networks.*
- *To have a complete picture of the data and computer networks systematically*
- *To provide a strong foundation in networking concepts and technology*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the basics of data communication, networking, internet, and their importance.
CO2	Analyze the services and features of various protocol layers in data networks.
CO3	Differentiate wired and wireless computer networks
CO4	Analyze TCP/IP and their protocols.
CO5	Recognize the different internet devices and their functions.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	2	2	1	3	2	2	1	1	2
CO2	3	3	3	2	2	1	3	3	2	2	2	3
CO3	3	2	3	2	2	1	3	2	2	2	2	3
CO4	3	3	3	2	2	2	3	3	2	2	2	3
CO5	2	2	2	2	2	1	2	2	2	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Data Communications** Introduction– Networks – The Internet – Protocols and Standards- Network Models: OSI model–TCP/IP protocol suite –Transmission Media: Guided media– Unguided Media.	**12**	**CO1**
2	**MODULE II: Data Link Layer** Error Detection and Correction: Introduction- Block coding – Linear block codes – Cyclic Codes – Checksum. Framing – Flow and Error Control: Protocols – Noiseless Channels: Stop and–Wait –Noisy Channel: Stop-and Wait Automatic Repeat Request-Go-Back –N.	**12**	**CO2**
3	**MODULE III: Medium Access and Network Layer** Multiple Access: Random Access–Controlled Access-Channelization. Network Layer Logical addressing: IPv4 addresses – IPv6 addresses. Transport Layer: Process – to Process delivery: UDP–TCP. Congestion Control– Quality of Service.	**12**	**CO3**
4	**MODULE IV: Application Layer** Domain Naming System: Name Space - Domain Name Space - Distribution of Name Space – DN Sonthe INTERNET-Resolution–Remote logging–e-mail – FTP.	**12**	**CO4**
5	**MODULE V: Wireless Networks** WirelessCommunications–PrinciplesandFundamentals.WLANs–WPAN-SatelliteNetworksAd-hocNetworks.	**12**	**CO5**

TEXT BOOKS:

1. Forouzan, A. Behrouz. (2016), Data Communications & Networking, Fourth Edition, Tata McGraw Hill Education.
2. Nicopolitidis, Petros, Mohammad Salameh Obaidat, G. L. Papadimitriou (2018), Wireless Networks, John Wiley & Sons.

REFERENCE BOOK:

1. Fred Halsall (1996), Data Communications Computer Networks and Open Systems, Fourth Edition, Addison Wesley.

E - REFERENCES:

1. https://www.geeksforgeeks.org/computer-network-tutorials/
2. https://www.netacad.com/
3. https://www.tutorialspoint.com/data_communication_computer_network/index.htm

THIRD SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-I- EMPLOYABILITY COURSE

Course Title: DSE-I (B) MOBILE COMPUTING

Course Code	**: 2566314(B)**	**Credits**	**: 03**
L: T: P: S	**: 3:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To understand the architecture, tools, and environment of mobile computing.*
- *To build foundational skills in developing mobile applications.*
- *To gain familiarity with mobile networking, sensors, storage, and cross-platform tools.*
- *To apply mobile computing concepts in real-time applications.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the basics of mobile computing and mobile development environments.
CO2	Apply mobile networking concepts and cloud-based communication methods.
CO3	Design and build interactive mobile UIs with local data management.
CO4	Integrate mobile sensors, multimedia, and cross-platform tools effectively.
CO5	Analyze real-world mobile app use cases and understand mobile deployment practices.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	1	3	2	2	1	2	2
CO2	3	3	3	2	2	1	3	3	3	2	2	3
CO3	3	2	3	2	2	2	3	3	2	3	2	3
CO4	3	2	3	2	3	2	3	3	3	3	2	3
CO5	3	2	3	2	3	2	3	3	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Mobile Computing:** Overview of mobile computing concepts; Types of mobile devices and operating systems; Introduction to mobile application development; Mobile sensors: GPS, accelerometer, gyroscope; Tools for mobile development: Android Studio, Xcode; Mobile UI design principles	**12**	**CO1**
2	**MODULE II: Mobile Networking and Communication:** Mobile networking technologies: Wi-Fi, Bluetooth, NFC; Client-server communication; REST APIs for mobile apps; Data exchange: JSON and XML parsing; Real-time data streaming with Web Sockets; Cloud-based mobile back ends: Firebase overview	**12**	**CO2**
3	**MODULE III: Mobile Application Development:** UI components: Buttons, Text Views, Lists; Event handling and gesture recognition; Local data storage: SQLite and Shared Preferences; Implementing notifications and alarms; Background services basics; Debugging and testing mobile applications	**12**	**CO3**
4	**MODULE IV: Advanced Mobile Computing Techniques:** Location-based services using GPS and Maps; Multimedia integration: Camera, Audio, Video APIs; Mobile security: Permissions, secure data storage; Introduction to cross-platform development tools: Flutter, React Native; Overview of future trends in mobile computing	**12**	**CO4**
5	**MODULE V: Case Studies and Applications:** Case studies of mobile applications in healthcare, transport, education, e-commerce, and finance; Comparative analysis of Android and iOS app ecosystems; Overview of mobile app deployment process; Legal and ethical considerations in mobile computing; Performance optimization and energy-aware design	**12**	**CO5**

TEXT BOOKS:

1. **Asoke K. Talukder, Hasan Ahmed, Roopa R. Yavagal** – *Mobile Computing*, 2nd Edition, McGraw Hill Education, 2010.
2. **Barry Burd** – *Android Application Development for Dummies,* 3rd Edition, Wiley, 2015.

REFERENCE BOOKS:

1. **Joseph Annuzzi Jr., Lauren Darcey, Shane Conder** – *Advanced Android Application Development*, 4th Edition, Addison-Wesley, 2014.
2. **Marco L. Napoli** – *Beginning Flutter: A Hands-On Guide to App Development*, 1st Edition, Wiley, 2019.

E - REFERENCES:

1. https://www.tutorialspoint.com/mobile_computing/index.htm
2. https://www.geeksforgeeks.org/mobile-computing/
3. https://ieeexplore.ieee.org/Xplore/home.jsp

THIRD SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-I- EMPLOYABILITY COURSE

Course Title: DSE-I –(C) ARTIFICIAL NEURAL NETWORKS

Course Code : 2566314(C)	**Credits 04**
L: T: P: S : 3:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To introduce the fundamentals of artificial neural networks and their applications.*
- *To understand various architectures of neural networks including feedforward, convolutional, and recurrent networks.*
- *To apply training algorithms and activation functions.*
- *To explore real-world applications in classification, prediction, and image recognition.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the fundamental concepts and structures of artificial neural networks.
CO2	Apply training methods, learning techniques, and error-correction mechanisms.
CO3	Build feedforward and deep neural network architectures for basic classification problems.
CO4	Analyze the working of CNNs, RNNs, and LSTMs in real-world scenarios.
CO5	Implement ANN models using frameworks and understand application-level deployment.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	1	1	3	2	2	2	2	2
CO2	3	3	3	2	2	1	3	3	3	2	2	3
CO3	3	2	3	2	2	2	3	3	3	3	2	3
CO4	3	3	3	2	2	2	3	3	3	3	3	3
CO5	3	2	3	2	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	Cos
1	**MODULE I: Introduction to Artificial Neural Networks:** Biological Neurons vs Artificial Neurons; History and Evolution of Neural Networks; McCulloch-Pitts Neuron Model; Perceptron and Limitations; Applications of ANN in Data Science; Types of Neural Networks: Feedforward, Feedback, Convolutional, Recurrent	**12**	**CO1**
2	**MODULE II: Neural Network Learning and Training:** Learning Processes: Supervised, Unsupervised, Reinforcement**;** Activation Functions: Sigmoid, Tanh, ReLU, SoftMax**;** Error Correction Learning – Delta Rule**;** Gradient Descent and Backpropagation**;** Epochs, Batch Size, Overfitting and Regularization**;** Evaluation Metrics: Loss Functions, Accuracy	**12**	**CO2**
3	**MODULE III: Feedforward and Deep Neural Networks:** Architecture of Feedforward Neural Networks; Multi-Layer Perceptron (MLP); Deep Neural Networks (DNNs); Weight Initialization and Optimization Techniques; Dropout and Normalization; Hyperparameter Tuning	**12**	**CO3**
4	**MODULE IV: Specialized Neural Networks:** Convolutional Neural Networks (CNNs): Layers, Pooling, Filters; Applications of CNNs in Image Recognition; Recurrent Neural Networks (RNNs): Structure and Applications; Long Short-Term Memory (LSTM) and Gated Recurrent MODULEs (GRU); Time-Series and Sequential Data Processing	**12**	**CO4**
5	**MODULE V: ANN Applications and Frameworks: Real**-world Use Cases in Healthcare, Finance, NLP, etc.; Introduction to TensorFlow and Kera's; Building and Training Simple ANN Models; Transfer Learning Basics; Model Deployment Overview; Ethical Considerations in AI	**12**	**CO5**

TEXT BOOKS:

1. **"Deep Learning: A Practical Introduction"** by Manel Martinez-Ramon, Meenu Ajith, and Aswathy Rajendra Kurup, 1st Edition, July 2024.
2. **"Optimization for Learning and Control"** by Anders Hansson and Martin Andersen, 1st Edition, May 2023.

REFERENCE BOOKS:

1. **"Understanding Deep Learning"** by Author Unknown, November 2023.
2. **"Artificial Neural Network and Deep Learning: Fundamentals and Theory"** by M. M. Hammad, August 2024.

E - REFERENCES:

1. https://www.deeplearning.ai/
2. https://www.geeksforgeeks.org/introduction-neural-network/
3. https://developer.ibm.com/articles/cc-neural-networks-deep-learning-architecture/

FOURTH SEMESTER

Course Title: CORE COURSE VIII- DATABASE SYSTEMS

Course Code : 2566417	**Credits 04**
L: T: P: S : 3:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To detail description of the structure of Database, file and records.*
- *To Structuring the models for Normalization of different Normal Forms.*
- *To emphasize the types of statements for control languages.*
- *To Demonstrate Subprograms, Functions and Procedures*
- *Elaborating the concepts of Triggers and Cursors*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To demonstrate the characteristics of Database Management Systems. To study the concepts and models of databases. To impart the concepts of System Development Life Cycle and E-R Model
CO2	To classify the keys and the concepts of Relational Algebra. To impart the applications of various Normal Forms Classification of Dependency.
CO3	To elaborate the different types of Functions and Joins and their applications. Introduction of Views, Sequence, Index and Procedure.
CO4	Representation of PL-SQL Structure. To impart the knowledge of Sub Programs, Function sand Procedures.
CO5	Representation of Exception and Pre-Defined Exception. To Point out the Importance of Triggers, Implicit and Explicit Cursors.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	1	3	2	2	3	2	2
CO2	3	3	3	2	2	1	3	3	2	3	2	3
CO3	3	2	3	2	2	1	3	3	3	3	3	3
CO4	3	2	3	2	2	2	3	3	3	3	3	3
CO5	3	2	3	2	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs	Cos
1	**MODULE I:** Introduction - Database System - Characteristics of Database Management Systems - Architecture of Database Management Systems - Database Models - System Development Life Cycle - Entity Relationship Model	**12**	**CO1**
2	**MODULE II:** Introduction to Relational Database Model-Structure of Relational Model –Keys -Relational Algebra-Normalization: Functional Dependency –First Normal form-Second Normal Form-Third Normal form-Boyce –Code Normal Form- Fourth Normal Form.	**12**	**CO2**
3	**MODULE III:** SQL: Introduction- Data Retrieval-Singlerowfunction-Groupfunction-SetFunction–Subquery-Joins.Data Manipulation Language: Insert, Update and Delete Statements –TransactionControlLanguage–View–Sequence–Synonym–Index-DefiningConstraints	**12**	**CO3**
4	**MODULE IV:** PL/SQL: Introduction- PL/SQL Basic-Character Set-PL/SQL Structure - SQL Cursor - Subprograms- Functions-Procedures.	**12**	**CO4**
5	**MODULE V:** Exception Handler Introduction- Predefined Exception-User Defined Exception–Triggers- Implicit and Explicit Cursors - Loops in Explicit Cursor.	**12**	**CO5**

TEXT BOOK:

1. Pranab Kumar Das Gupta and P. Radha Krishnan, "Database Management System Oracle SQL and PL/SQL", Second Edition, 2013, PHI Learning Private Limited.

REFERENCE BOOKS:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fifth Edition, 2007, Pearson Publications.
2. Abraham Silberschatz, Henry Korth, S. Sudarshan, "Database System Concepts", Sixth Edition, 2010, Mc-1Graw Hill Education.

E - REFERENCES:

1. https://docs.oracle.com/en/database/
2. https://www.ionos.com/digitalguide/hosting/technical-matters/oracle-database/
3. https://en.wikipedia.org/wiki/Oracle_Database

FOURTH SEMESTER

Course Title: CORE COURSE IX- ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Course Code	**: 2566418**	**Credits**	**: 04**
L: T:P:S	**: 3:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Introduce foundational concepts and techniques in Artificial Intelligence (AI).*
- *Explore problem-solving, knowledge representation, and reasoning methods.*
- *Understand machine learning algorithms and their applications.*
- *Examine real-world AI applications and ethical considerations.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Explain fundamental AI concepts and terminologies.
CO2	Apply search algorithms and knowledge representation techniques to solve problems.
CO3	Analyze machine learning models and evaluate their performance.
CO4	Develop simple AI applications using appropriate tools and frameworks.
CO5	Assess the ethical implications and societal impact of AI technologies.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO / PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	2	1	3	2	2	3	2	2
CO2	3	3	2	2	2	1	3	3	3	3	2	3
CO3	3	2	3	2	2	2	3	3	3	3	3	3
CO4	3	2	3	2	3	2	2	3	2	3	3	3
CO5	2	2	2	3	2	2	1	2	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Artificial Intelligence** Definition and history of AI; Applications of AI in various domains; Intelligent agents and environments; Problem-solving approaches; Overview of AI programming languages and tools	**12**	**CO1**
2	**MODULE II: Problem Solving and Search Strategies** Uninformed search strategies: BFS, DFS; Informed search strategies: Greedy search, A* algorithm; Heuristics and optimization; Constraint satisfaction problems; Game playing: Minimax algorithm, Alpha-beta pruning	**12**	**CO2**
3	**MODULE III: Knowledge Representation and Reasoning** Propositional and predicate logic; Inference rules and resolution; Semantic networks and frames; Ontologies and description logics; Reasoning under uncertainty: Bayesian networks	**12**	**CO3**
4	**MODULE IV: Machine Learning Fundamentals** Supervised learning: Regression, classification; Unsupervised learning: Clustering, dimensionality reduction; Reinforcement learning basics; Model evaluation and validation techniques ;Introduction to neural networks	**12**	**CO4**
5	**MODULE V: AI Applications and Ethical Considerations** Natural Language Processing (NLP); Computer vision and image processing; Robotics and autonomous systems; AI in healthcare, finance, and other industries; Ethical, legal, and societal implications of AI	**12**	**CO5**

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig;4th Edition, Pearson, 2020.
2. Hands-On Artificial Intelligence for Beginners by Patrick D. Smith;1st Edition, Packt Publishing, 2022.

REFERENCE BOOKS:

1. Artificial Intelligence: Foundations of Computational Agents by David L. Poole & Alan K. Mackworth;2nd Edition, Cambridge University Press, 2017.
2. AI 2041: Ten Visions for Our Future by Kai-Fu Lee & Chen Qiufan;1st Edition, Currency, 2021.

E - REFRENCES:

1. https://en.wikipedia.org/wiki/Artificial_intelligence
2. https://www.ibm.com/think/topics/artificial-intelligence
3. https://www.sas.com/en_us/insights/analytics/what-is-artificial-intelligence.html

FOURTH SEMESTER

Course Title: CORE COURSE X – CRYPTOGRAPHY

Course Code : 2566419	**Credits :04**
L: T: P: S : 3:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To understand the fundamentals of Cryptography*
- *To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.*
- *To understand the various key distribution and management schemes.*
- *To understand how to deploy encryption techniques to secure data in transit across data networks*
- *To design security applications in the field of Information technology*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3	Apply the different cryptographic operations of public key cryptography
CO4	Apply the various Authentication schemes to simulate different applications.
CO5	Understand various Security practices and System security standards

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	2	2	3	2	3	3	3	2
CO2	3	2	3	2	2	2	3	3	2	3	3	3
CO3	3	2	3	2	2	2	3	3	2	3	3	3
CO4	3	2	3	3	2	2	3	2	2	3	3	3
CO5	3	3	2	3	2	2	2	2	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	Cos
1	**MODULE I: Introduction** The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.	**12**	**CO1**
2	**MODULE II: Classical Encryption Techniques** Symmetric cipher model – **Substitution Techniques:** Caesar Cipher – Mono alphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography	**12**	**CO2**
3	**MODULE III: Block Cipher and DES** Block Cipher Principles – DES – The Strength of DES –**RSA:** The RSA algorithm.	**12**	**CO3**
4	**MODULE IV: Network Security Practices** IP Security overview - IP Security architecture – Authentication Header. **Web Security**: Secure Socket Layer and Transport Layer Security – Secure Electronic Transaction.	**12**	**CO4**
5	**MODULE V:** Intruders – Malicious software – Firewalls.	**12**	**CO5**

TEXT BOOK:

1. William Stallings, "Cryptography and Network Security Principles and Practices".

REFERENCE BOOKS:

1. Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw-Hill, 2007.

2. Atul Kahate, "Cryptography and Network Security", Second Edition, 2003, TMH.
3. M.V. Arun Kumar, "Network Security", 2011, First Edition, USP

E - REFERENCES:

1. https://www.idrbtca.org.in/inf_crypto.htm?utm_source=chatgpt.com
2. https://www.geeksforgeeks.org/introduction-to-crypto-terminologies?utm_source=chatgpt.com
3. https://www.isical.ac.in/~malapati_r/crypt.html?utm_source=chatgpt.com

FOURTH SEMESTER

Course Title: CORE PRACTICAL IV – DATABASE SYSTEMS LAB

Course Code	**: 2566421**	**Credits**	**: 02**
L: T: P: S	**: 0:1:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Apply basic SQL commands.*
- *Retrieve and analyze data using SQL joins and subqueries*
- *Develop PL/SQL programs using control structures and exception handling*
- *Implement and utilize advanced PL/SQL components*
- *Perform effective data manipulation using PL/SQL*

Course outcome: the end of course, the student will be able to

CO1	Apply basic SQL operations by using DDL and DML commands along with implementing various integrity constraints.
CO2	Demonstrate SQL joins and use subqueries for effective relational database querying and analysis.
CO3	Create PL/SQL programs by using control structures and exception handling mechanisms for building robust and logical database applications.
CO4	Implement advanced PL/SQL programming concepts such as cursors, procedures, and triggers for efficient data processing, modular programming, and automated database operations.
CO5	Perform data manipulation operations using PL/SQL for building interactive database applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	2	2	3	2	3	3	3	2
CO2	3	2	3	2	2	2	3	3	2	3	3	3
CO3	3	2	3	2	2	2	3	3	2	3	3	3
CO4	3	2	3	3	2	2	3	2	2	3	3	3
CO5	3	3	2	3	2	2	2	2	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**SQL Commands and Constraints** a. DDL commands. b. Specifying constraints - primary key, foreign key, unique, check, not null. c. DML commands	9	**CO1**
2	**Advanced SQL Query Techniques** a. Joins. b. Subqueries.	9	**CO2**
3	**PL/SQL Block Programming** a. Creation of a simple PL/SQL block using control constructs. b. Creation of PL/SQL blocks using exceptional handlers.	9	**CO3**
4	**Advanced PL/SQL Programming** a. PL/SQL program using implicit and explicit cursor. b. PL/SQL program using procedures. c. PL/SQL program using triggers.	9	**CO4**
5	**Data Manipulation using PL/SQL.**	9	**CO5**

REFERENCE BOOKS :

1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. **"Fundamentals of Database Systems" by** Ramez Elmasri, Shamkant B. Navathe, Pearson
3. "Learning Oracle PL/SQL" by Bill Pribyl, Steven Feuerstein, O'Reilly Media

FOURTH SEMESTER

Course Title: CORE PRACTICAL V – ARTIFICIAL INTELLIGENCE ALGORITMS LAB

Course Code	**: 2566422**	**Credits**	**: 02**
L:T:P:S	**: 0:1:3:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To design and implement search strategies.*
- *To implement game playing techniques.*
- *To implement CSP Techniques.*
- *To develop System with Logical and Probabilistic reasoning.*

Course outcome: the end of course, the student will be able to

CO1	To implement basic AI search strategies**.**
CO2	To apply heuristic and informed search algorithms.
CO3	To explore decision-making techniques in adversarial environments **.**
CO4	To design and develop solutions for logic-based and rule-based reasoning systems**.**
CO5	To build and evaluate probabilistic reasoning models**.**

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	2	2	3	2	3	3	3	2
CO2	3	2	3	2	2	2	3	3	2	3	3	3
CO3	3	2	3	2	2	2	3	3	2	3	3	3
CO4	3	2	3	3	2	2	3	2	2	3	3	3
CO5	3	3	2	3	2	2	2	2	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	Implementation Basic search strategies – 8-Puzzle,8-Queens problems, Crypt arithmetic.	9	**CO1**
2	**Heuristic and Adversarial Search Algorithms** a. Implement A* and memory bounded A* algorithm. b. Implement minimax algorithm for game playing (Alpha-Beta pruning).	9	**CO2**
3	Solve Constraint Satisfaction problems.	9	**CO3**
4	**Logic-Based Reasoning and Inference Techniques** a. Implement propositional model checking algorithms. b. Implement forward chaining, backward chaining and resolution strategies.	9	**CO4**
5	**Probabilistic Reasoning and Inference Models** a. Build Naïve Bayes models. b. Implement Bayesian networks and perform inferences.	9	**CO5**

REFERENCE BOOKS :

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell, Peter Norvig, Pearson
2. "Artificial Intelligence and Intelligent Systems" by N.P. Padhy, Oxford University Press
3. "Principles of Artificial Intelligence" by Nils J. Nilsson, Morgan Kaufmann

FOURTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE II - ENTREPRUESHIP COURSE

Course Title: DSE-II-(A) BUSINESS ANALYTICS

Course Code	**: 2566420(A)**	**Credits**	**: 03**
L: T: P: S	**: 2:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To understand the Analytics Life Cycle.*
- *To comprehend the process of acquiring Business Intelligence*
- *To understand various types of analytics for Business Forecasting*
- *To model the supply chain management for Analytics.*
- *To apply analytics for different functions of a business*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand and apply fundamental statistical techniques to analyze business data.
CO2	Use data visualization tools to interpret and communicate business data insights effectively.
CO3	Develop the ability to make informed business decisions based on data analysis.
CO4	Understand and apply various decision-making models and frameworks that use analytics to support business strategies.
CO5	Gain proficiency in HR & supply chain analytics

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	1	2	1	3	2	2	2	2	2
CO2	2	3	3	1	3	2	3	2	3	2	3	3
CO3	3	3	2	2	2	2	3	3	3	2	3	3
CO4	2	3	2	3	2	2	3	2	3	2	3	3
CO5	2	3	2	2	2	2	2	3	3	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to business analytics** Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration	**9**	**CO1**
2	**MODULE II: Business intelligence** Data Warehouses and Data Mart - Knowledge Management – Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions	**9**	**CO2**
3	**MODULE III: Business forecasting** Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.	**9**	**CO3**
4	**MODULE IV: HR & supply chain analytics** Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain.	**9**	**CO4**
5	**MODULE V: Marketing & sales analytics** Marketing Strategy, Marketing Mix, Customer Behavior –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behavior in marketing and sales.	**9**	**CO5**

TEXT BOOKS:

1. "Business Analytics: Data Analysis & Decision Making" by S. Christian Albright and Wayne L. Winston
2. “Business Analytics: A Data-Driven Decision-Making Approach" by U Dinesh Kumar

REFERENCE BOOKS:

1. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett
2. "Analytics: The Agile Way" by Bernard Marr

E - REFERENCES:

1. https://www.tableau.com/learn/articles/what-is-business-analytics?utm_source=chatgpt.com
2. https://online.hbs.edu/blog/post/business-analytics-examples?utm_source=chatgpt.com
3. https://www.simplilearn.com/types-of-business-analytics-tools-examples-jobs-article?utm_source=chatgpt.com

FOURTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE II - ENTREPRUESHIP COURSE

Course Title: DSE-II-(B)- TEXT ANALYTICS

Course Code	**: 2566420(B)**	**Credits**	**: 03**
L: T: P: S	**: 2:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Demonstrate a foundational understanding of text data structure, challenges, and common text analytics workflows.*
- *Apply key text preprocessing techniques such as tokenization, stemming, lemmatization, and stop word removal effectively.*
- *Represent textual data using models like Bag of Words (Bow), Term Frequency-Inverse Document Frequency (TF-IDF), word embeddings, and transformer-based encodings.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate the ability to apply text preprocessing techniques.
CO2	Use various text representation methods to convert raw text into structured formats suitable for analysis.
CO3	Utilize NLP techniques such as named entity recognition, part-of-speech tagging, and sentiment analysis to extract meaningful information from text.
CO4	Develop and implement text classification and clustering models using machine learning algorithms
CO5	Understand and apply deep learning techniques

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	1	3	3	2	3	3	2
CO2	3	3	2	1	2	1	3	3	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3	3	3	3
CO5	3	3	3	2	2	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE I: Introduction to Text Analytics** Importance & Applications of Text Analytics-Raw Text vs Structured Data-Text Mining vs Text Analytics-Key Challenges: Ambiguity, Irregularity, and Language Richness.	**9**	**CO1**
2	**MODULE II: Text Preprocessing and Cleaning** Text Preprocessing Steps: Tokenization, Sentence Segmentation, Normalization ,Stop word Removal, Stemming & Lemmatization	**9**	**CO2**
3	**MODULE III: NLP Essentials for Text Analytics** NLP Core Concepts: POS Tagging, Named Entity Recognition (NER), Chunking -Sentiment Analysis Techniques-Text Similarity Measures: Cosine Similarity, Jaccard Similarity	**9**	**CO3**
4	**MODULE IV: Text Classification & Clustering** Supervised Learning Techniques: Naive Bayes, Logistic Regression, SVM - Feature Extraction: Bag of Words (Bow), TF-IDF-Performance Metrics: Precision, Recall, F1-score-Clustering Overview: K-Means.	**9**	**CO4**
5	**MODULE V: Intro to Deep Learning for Text** Basics of Neural Networks: Feedforward Network, Activation Functions-Recurrent Neural Networks (RNN)-LSTM (conceptual level).	**9**	**CO5**

TEXT BOOKS:

1. "Text Analytics with Python" by Dipanjan Sarkar
2. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, Edward Loper
3. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin

REFERENCE BOOKS:

1. "Deep Learning for Natural Language Processing" by Palash Goyal, Sumit Pandey, Karan Jain
2. "Introduction to Information Retrieval" by Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop

E - REFERENCES:

1. https://go.documentation.sas.com/doc/en/espcdc/6.2/espstudio/p1sjh297f43h3xn1i7r01mzss9fw.htm?utm_source=chatgpt.com
2. https://aws.amazon.com/what-is/text-analysis/
3. https://libguides.gwu.edu/textanalysis/methods

FOURTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE II - ENTREPRUESHIP COURSE

Course Title: DSE-II -(C) - SOCIAL NETWORK ANALYTICS

Course Code	**: 2566420(C)**	**Credits**	**: 03**
L: T: P: S	**: 2:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Grasp the fundamental concepts of social networks, including nodes, edges, and various types of networks (e.g., undirected, directed, weighted).*
- *Understand the basics of graph theory and its application to social network analysis, including concepts such as centrality, shortest path, connectedness, and clustering.*
- *Develop the ability to collect, process, and analyze data from social networks, focusing on understanding user interactions, relationships, and commMODULEy structures.*
- *Implement graph algorithms to identify key network structures such as commMODULEies, influential nodes (central nodes), and clusters in social networks*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the basic concepts of social networks
CO2	Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks
CO3	Implement mining algorithms for social networks
CO4	Exploring techniques for analyzing the temporal aspects of social network data and understanding how networks change over time.
CO5	Perform mining on large social networks and illustrate the results.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO /PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	2	2	2	2
CO2	3	3	2	2	2	2	3	3	3	2	3	3
CO3	3	3	3	2	2	2	3	3	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3	3	3	3
CO5	3	3	3	2	2	2	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Social Network Mining** Overview of Social Network Mining-Real-world Applications & Examples-Social Networks as Graphs-Key Graph Models: Erdős-Rényi, Preferential Attachment, Small-World Networks	**9**	**CO1**
2	**MODULE II: Graph-Based Analysis of Social Networks** Graph Exploration Techniques-Centrality Measures: Degree, Betweenness, Closeness-CommMODULEy Detection -Clustering of Graphs-Graph Partitioning Basics-Introduction to **SNAP** for large-scale network analysis	**9**	**CO2**
3	**MODULE III: Structural Properties and Similarity** Overlapping CommMODULEies -Graph Node Similarity-Triangle Counting & Neighborhood Analysis-Introduction to Pregel Paradigm.	**9**	**CO3**
4	**MODULE IV: Information Diffusion and Influence** Information Diffusion Models: Cascades, Influence Maximization, Epidemic Models-Introduction to Opinion Analysis: Contagion, Basic Coordination Models	**9**	**CO4**
5	**MODULE V: Dynamics & Applications of Social Networks** Dynamic Social Networks: Concept and Use Cases-Link Prediction Techniques-Social Learning Overview-Applications in: Marketing, Health, Recommendation Systems.	**9**	**CO5**

TEXT BOOKS:

1. "Social Network Analysis: Methods and Applications" by Wasserman, S., & Faust, K.
2. "Analyzing Social Networks" by Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson

REFERENCE BOOKS:

1. "Graph Theory and Complex Networks" by Maarten van Steen
2. "Social Media Mining: An Introduction" by Reza Zafarani, Mohammad Ali Abbasi, Huan Liu

E - REFERENCES:

1. https://www.sciencedirect.com/topics/computer-science/social-network-analysis?utm_source=chatgpt.com
2. https://visiblenetworklabs.com/2023/06/20/what-is-social-network-analysis?utm_source=chatgpt.com
3. https://www.geeksforgeeks.org/top-10-social-network-analysis-tools-to-consider?utm_source=chatgpt.com

FIFTH SEMESTER

Course Title: CORE COURSE XI- FUNDAMENTALS OF MACHINE LEARNING

Course Code : 2566523	**Credits : 04**
L: T: P: S : 4:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESC Marks : 100**

Learning Objectives:

- *To Learn about Machine Intelligence and Machine Learning applications*
- *To implement and apply machine learning algorithm store real-world applications.*
- *To identify and apply the appropriate machine learning* technique to classification, pattern *recognition, optimization and decision problems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Appreciate the importance of visualization in the data analytics solution.
CO2	Apply structured thinking to unstructured problems
CO3	Understand a very broad collection of machine learning algorithms and problems.
CO4	Learn algorithmic topic soft machine learning and mathematically deep enough to introduce the required theory.
CO5	Develop an appreciation for what is involved in learning from data.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	2	3	1	2	2	1	1	1	2
CO2	2	3	2	2	3	1	2	2	2	1	1	3
CO3	3	3	3	3	2	1	3	3	2	1	1	3
CO4	3	3	3	2	2	1	3	3	3	2	1	3
CO5	2	2	2	2	2	2	2	3	2	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I – Introduction** Machine Learning - Difference between AI, Machine Learning and Big data. Supervised and unsupervised learning, parametric vs non- parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier- K-nearest neighbour, support vector machines.	**15**	**CO1**
2	**MODULE II – Neural Networks and Evolutionary Methods** Neural Network Representation–Problems–Perceptrons–Multilayer Networks and Back Propagation Algorithms	**15**	**CO2**
3	**MODULE III – Bayesian and Probabilistic Learning** Bayes Theorem -Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning	**15**	**CO3**
4	**MODULE IV –Instance-Based and Lazy Learning** K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.	**15**	**CO4**
5	**MODULE V – Advanced Learning Topics** Recommendation systems – Opinion Mining, Sentiment Analysis. Learning Sets of Rules – Learning Rule Set – First Order Rules – Sets of First Order Rules -Analytical Learning Explanation Base Learning – Reinforcement Learning	**15**	**CO5**

TEXT BOOKS:

1. Tom M. Mitchell, ―Machine Learning, McGraw- HillEducation (India) PrivateLimited,2013.
2. Bengio, Yoshua, IanJ. Good fellow and Aaron Courville. "Deep learning"2015, MIT Press.
3. "Sentiment Analysis and Opinion Mining" by Bing Liu (Morgan & Claypool Publishers)

REFERENCE BOOKS:

1. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning),TheMIT Press 2004.
2. "Recommender Systems: An Introduction" by Dietmar Jannach et al.
3. "Artificial Intelligence: A Modern Approach" by Stuart Russell & Peter Norvig

E-REFERENCES:

1. 1.https://www.tpointtech.com/supervised-machine-learning
2. https://trevormcguire.medium.com/artificial-selection-evolution-and-neural-networks-96cb2b7b9db4#:~:text=The%20main%20difference%20is%20that,traditional%20Deep%20Learning%20loss%20function.

FIFTH SEMESTER

Course Title: CORE COURSE XII-DATA HANDLING AND VISUALIZATION

Course Code	**: 2566524**	**Credits**	**: 04**
L: T:P :S	**: 4:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *To introduce students to data types, data structures, and basic data handling techniques.*
- *To provide students with the tools and techniques to clean and preprocess data for analytics*
- *To introduce fundamental concepts of data visualization and the importance of presenting data clearly.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand foundational concepts in data handling and visualization.
CO2	Master data preprocessing and cleaning techniques.
CO3	Perform effective exploratory data analysis (EDA) to summarize datasets.
CO4	Design and create meaningful data visualizations.
CO5	Develop and deploy interactive visualizations and reports.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	2	1	2	2	1	1	1	2
CO2	3	3	2	2	2	1	3	2	1	1	1	3
CO3	3	3	3	3	3	2	3	3	2	2	2	3
CO4	3	2	3	2	3	2	3	3	2	2	2	3
CO5	2	2	2	2	3	2	3	3	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Data Handling** Overview of Data Handling: Importance of data in the modern World-Types of Data-Data formats. Data Types and Structures: Primitive data Types-Complex Data Types-Data frames and tables. Data Importing and Exporting: Reading data from Files-Writing data to Files-Data cleaning.	**15**	**CO1**
2	**MODULE II: Data Preprocessing and Cleaning** Data Cleaning Techniques: Handling missing Data-Data normalization and Standardization-Removing duplicates and outliers. Data Transformation: Data type Conversion-Data scaling and encoding. Data Integration: Merging Datasets-Handling inconsistent data Formats-Data reshaping and pivoting.	**15**	**CO2**
3	**MODULE III: Introduction to Data Visualization** Importance of Data Visualization-Role of visualizations in data Analysis-Principles of effective visualization. Basic Types of Visualizations: Bar charts, histograms, line charts etc., Visualization Tools - Introduction to interactive visualizations - Customizing Visualizations: Customizing axis labels, titles, and Legends-Working with colors, styles, and themes.	**15**	**CO3**
4	**MODULE IV: Advanced Data Visualization Techniques** Multivariate Visualizations: Pair plots, facet grids-Heatmaps, correlation Plots-Contour plots and 3D plots. Geospatial Visualizations: Introduction to geospatial Data-Mapping with folium (Python) and leaflet (R)-Visualizing geospatial data.	**15**	**CO4**
5	**MODULE V: Data Storytelling and Reporting** Principles of Data Storytelling- Dash boarding and Interactive Visualizations-Best Practices for Presenting Data- Automating Data Reports.	**15**	**CO5**

TEXT BOOKS:

1. Comprehensive Guide To Data Handling And Data Visualization: Hands-on Practices (Book, Sharon Munigety, Radhika Sreedharan, S.Saravana Kumar, Geetha A)
2. Beginners Guide to Data Visualization: How to Understand, Design, and Optimize Over 40 Different Charts (All Things Data) Kindle Edition by Elizabeth Clarke (Author)
3. Designing Data Visualizations by Noah Iliinsky (Author), Julie Steele (Author)

REFERENCE BOOKS:

1. Edward R. Tufte "The Visual Display of Quantitative Information" Graphics Press publications, 2001 (2nd Edition)

E- REFERENCES:

1. 1.https://www.cuemath.com/data/data-handling.
2. 2.https://www.tableau.com/visualization/what-is-data-visualization

FIFTH SEMESTER

Course Title: CORE PRACTICAL VI – MACHINE LEARNING TECHNIQUES LAB

Course Code	**: 2566527**	**Credits**	**:02**
L: T: P:S	**: 0:1:3:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *To discover patterns in the user data and then make predictions based on these and intricate patterns for answering business questions and solving business problems.*

Course Outcome: At the end of the Course, the Student will be able to:

CO1	Demonstrate the ability to read and manipulate data files and preprocess them for ML models..
CO2	Implement supervised learning algorithms including Find-S, Candidate Elimination, and ID3.
CO3	Apply probabilistic and statistical models such as Naïve Bayes and EM clustering
CO4	Construct and evaluate artificial neural networks and instance-based learning models.
CO5	Perform model evaluation using classification metrics such as accuracy, precision, and recall.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	2	1	2	2	1	1	1	2
CO2	3	3	2	2	2	1	3	2	1	1	1	3
CO3	3	3	3	3	3	2	3	3	2	2	2	3
CO4	3	2	3	2	3	2	3	3	2	2	2	3
CO5	2	2	2	2	3	2	3	3	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs	COs
1	**Data Handling and Pre processing** a. Reading/writing .csv file. b. Data cleaning and manipulation in Python	**9**	**CO1**
2	**Supervised Learning - Concept Learning** a. Implementing Find-S algorithm. b. Candidate-Elimination algorithm. c. ID3 Decision Tree for classification	**9**	**CO2**
3	**Probabilistic and Statistical Learning** a. Naïve Bayesian classifier b. K-means clustering using EM c. Evaluation using accuracy, precision, recall	**9**	**CO3**
4	**Neural and Instance-Based Learning** a. Backpropagation for ANN b. k-Nearest Neighbour algorithm c. Locally Weighted Regression	**9**	**CO4**
5	**Performance Evaluation and Model Metrics** a. Evaluate classification models b. Calculate accuracy, precision, recall, F1 score	**9**	**CO5**

REFERENCE BOOKS

1. Wes McKinney, *Python for Data Analysis*, O'Reilly.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly.
3. Peter Bruce & Andrew Bruce, *Practical Statistics for Data Scientists*, O'Reilly.
4. Tom M. Mitchell, *Machine Learning*, McGraw-Hill.
5. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press.

FIFTH SEMESTER

Course Title: CORE PRACTICAL VII –DATA HANDLING AND VISUALIZATION LAB

Course Code	**: 2566528**	**Credits**	**:02**
L: T: P: S	**: 0:1:3:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *To develop proficiency in collecting, processing, and analyzing data to uncover trends, patterns, and insights.*
- *Utilize advanced data visualization tools to effectively communicate findings, enabling data-driven decision-making and promoting clear understanding across stakeholders*.

Course Outcome: At the end of the Course, the Student will be able to:

CO1	Perform data import, export, and preprocessing to prepare datasets for analysis.
CO2	Analyze and summarize data using aggregation and grouping techniques.
CO3	Apply a variety of visualization techniques including charts, scatter plots, and box plots.
CO4	Use time series and heatmap visualizations to discover temporal and spatial patterns.
CO5	Create interactive visualizations and dashboards for effective data storytelling.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	2	2	2	2	2	1	2	2	1	1	1	2
CO2	3	3	2	2	2	1	3	2	1	1	1	3
CO3	3	3	3	3	3	2	3	3	2	2	2	3
CO4	3	2	3	2	3	2	3	3	2	2	2	3
CO5	2	2	2	2	3	2	3	3	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**Data Import, Export, and Preprocessing** a. Import/export data formats (CSV, Excel, JSON) b. Handling missing data c. Data cleaning & normalization	**9**	**CO1**
2	**Data Aggregation and Grouping** a. GroupBy operations b. Aggregation functions c. Summarization and pivot tables	**9**	**CO2**
3	**Basic and Statistical Visualizations** a. Bar, Line, Pie charts b. Scatter plots & correlation analysis c. Box plots & outlier detection	**9**	**CO3**
5	**Advanced Visualization Techniques** a. Time series plots b. Heatmaps c. Multivariate data plots	**9**	**CO4**
5	**Interactive Visualization and Dashboards** a. Plotly and interactive charts b. Dashboard creation with tools like Streamlit/Tableau	**9**	**CO5**

REFERENCE BOOKS

1. **Wes McKinney**, *Python for Data Analysis*, O'Reilly Media
2. **Nathan Yau**, *Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*
3. **Alberto Cairo**, *The Truthful Art: Data, Charts, and Maps for Communication*
4. **Ben Fry**, *Visualizing Data: Exploring and Explaining Data with the Processing Environment*
5. **Claus O. Wilke**, *Fundamentals of Data Visualization*

FIFTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-III- EMPLOYABILITY COURSE

Course Title: DSE III- (A) INFORMATION AND CYBER SECURITY

Course Code : 2566525(A)	**Credits :03**
L: :P:S : 4:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *Understand the fundamental concepts of information security, including the CIA triad (Confidentiality, Integrity, Availability).*
- *Identify various types of cybersecurity threats and attacks.*
- *Analyze the security challenges posed by emerging technologies.*
- *Apply practical knowledge of cybersecurity through ethical hacking, penetration testing, and using security tools to safeguard information systems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the key concepts, principles, and importance of information security and the CIA triad.
CO2	Apply cryptographic techniques and understand network security measures to protect data and systems
CO3	Identify, analyze, and defend against common cyber threats and attacks through proactive measures.
CO4	Understand the security challenges and solutions associated with emerging technologies such as Cloud, IoT, and AI.
CO5	Recognize legal, ethical, and policy aspects of cybersecurity, and understand digital forensics and incident response techniques

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	2	2	2	2	1	1	1	2
CO2	3	3	3	2	3	2	3	3	2	2	2	3
CO3	3	3	3	3	3	2	3	3	3	2	2	3
CO4	2	2	2	3	3	2	2	2	3	2	2	3
CO5	2	2	2	2	2	3	2	2	2	3	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I: Introduction to Information Security** Overview of Information Security: Definition, Importance, and Concepts - History and Evolution of Cyber security - Key Principles of Information Security: Confidentiality, Integrity, Availability (CIA Triad) - Cyber Threats and Attacks: Malware, Viruses, Worms, Ransomware, Phishing – Cyber security Frameworks and Standards - Security Policies and Risk Management.	**15**	**CO1**
2	**MODULE II: Cryptography and Network Security** Introduction to Cryptography: Symmetric and Asymmetric Encryption - Cryptographic Algorithms: AES, RSA, SHA, DES, and ECC - Public Key Infrastructure (PKI): Key Management, Digital Certificates, and Digital Signatures - Network Security: Firewalls, Intrusion Detection Systems (IDS), Intrusion Prevention Systems (IPS)	**15**	**CO2**
3	**MODULE III: Cyber security Threats and Attacks** Types of Cyber Attacks - Social Engineering: Phishing, Spear Phishing, Pretexting, Baiting - Hacking Techniques and Countermeasures: Ethical Hacking, Penetration Testing - Malware Analysis: Virus, Worms, Trojans, Spyware, Ransomware	**15**	**CO3**
4	**MODULE IV: Cyber security in Modern Technologies** Cloud Security: Security Challenges and Solutions in Cloud Computing - Internet of Things (IoT) Security: Vulnerabilities, Threats, and Countermeasures - Mobile Security – Block chain and Crypto currency Security: Block chain Technology, Smart Contracts, and Crypto currency Threats - Artificial Intelligence in Cyber security: Machine Learning for Threat Detection and Prevention - Security in Critical Infrastructure.	**15**	**CO4**
5	**MODULE V: Legal, Ethical, and Policy Issues in Cyber security** Cyber Laws and Regulations: Data Privacy Laws, Cybercrime Laws, Intellectual Property Protection - Ethical Hacking and Legal Implications: Ethical Considerations in Hacking and Penetration Testing - Digital Forensics – Cyber security Policies and Governance – Cyber security and Society - Emerging Trends and Future of Cyber security.	**15**	**CO5,**

TEXT BOOKS:

1. "Principles of Information Security" by Michael E. Whitman & Herbert J. Mattord. Publisher: Cengage Learning, 6th Edition.
2. "Cryptography and Network Security: Principles and Practice" by William Stallings, Pearson, 7th Edition.

REFERENCE BOOKS:

1. "Introduction to Modern Cryptography" by Jonathan Katz & Yehuda Lindell, CRC Press.
2. "Cybersecurity and Cyberwar: What Everyone Needs to Know" by P.W. Singer & Allan Friedman, Oxford University Press.

E- REFERENCE:

1. https://www.imperva.com/learn/data-security/information-security

FIFTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-III- EMPLOYABILITY COURSE

Course Title: DSE III- (B) BLOCK CHAIN TECHNOLOGY

Course Code : 2566525(B)	**Credits :03**
L: T: P: S : 4:1:0:0	**CIA Marks :50**
Exam Hours : 03	**ESE Marks: 100**

Learning Objectives:

- *Comprehend the basic principles of block chain technology, including its decentralized nature, cryptographic foundations, and distributed ledger systems.*
- *Gain knowledge about the architecture of block chain, including nodes, miners, blocks, chains, and consensus mechanisms.*
- *Be able to design, build, and deploy simple block chain-based applications using smart contracts and other block chain tools*
- *Understand different consensus mechanisms (Proof of Work, Proof of Stake, Delegated Proof of Stake, etc.), and critically evaluate their trade-offs, efficiency, and security in various block chain networks.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the types, benefits and limitation of block chain
CO2	Explore the block chain decentralization and cryptography concepts.
CO3	Enumerate the Bitcoin features and its alternative options.
CO4	Describe and deploy the smart contracts
CO5	Summarize the block chain features outside of currencies

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	2	2	1	2	2	1	1	1	2
CO2	3	3	2	3	2	1	3	2	2	1	1	3
CO3	3	3	2	2	2	2	3	2	2	2	2	3
CO4	3	3	3	2	3	1	3	3	3	2	2	3
CO5	2	2	2	2	3	2	2	2	2	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE - I** What is Block chain, Block chain Technology Mechanisms & Networks, Block chain Origins, Objective of Block chain, Block chain Challenges, Transactions And Blocks.	**15**	**CO1**
2	**MODULE-II** P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain. CAP theorem and block chain, Block chain Network, Mining Mechanism.	**15**	**CO2**
3	**MODULE-III** Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain. Benefits and limitations of block chain.	**15**	**CO3**
4	**MODULE-IV** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, utilization and alternate.	**15**	**CO4**
5	**MODULE-V** Decentralization Decentralization using block chain, Methods of decentralization, Routes to decentralization, Decentralized organizations.	**15**	**CO5**

TEXT BOOKS:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, 4th Edition, Packt Publishing, 2023.
2. Narayanan, Arvind et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, Updated Edition 2023.

REFERENCE BOOKS:

1. Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, 2nd Edition, O'Reilly, Revised 2023.
2. Joseph J. Bambara, Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, 2nd Edition, McGraw-Hill, 2023.

E- REFERENCES:

1. https://www.techtarget.com/searchcio/definition/blockchain.
2. https://www.sciencedirect.com/topics/computer-science/identity-based-cryptography.

FIFTH SEMESTER

DISCIPLINE SPECIFIC ELECTIVE-III- EMPLOYABILITY COURSE

Course Title: DSE III- (C) DEEP LEARNING

Course Code : 2566525(C)	**Credits :03**
L: T: P: S : 4:1:0:0	**CIA Marks: 50**
Exam Hours : 03	**ESE Marks:100**

Learning Objectives:

- *To understand the theory behind deep learning methods such as Convolutional Neural Networks, Auto encoders and Boltzmann Machines*
- *Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.*
- *To have a grasp of the open issues and trends in deep learning research.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Design user interfaces to improve human–AI interaction and real-time decision-making.
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.
CO4	Extract information from text automatically using concepts and methods from natural language processing (NLP), including stemming, n-grams, POS tagging, and parsing
CO5	Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	3	2	2	2	2	2	1	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3
CO3	3	2	2	2	3	2	3	2	2	2	2	3
CO4	2	2	3	2	3	2	2	3	3	2	2	3
CO5	2	2	2	2	3	2	2	2	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs	COs
1	**MODULE I –Introduction** Overview of machine learning, linear classifiers, loss functions What Are Neural Networks: History, Artificial and biological neural networks, Artificial intelligence and neural networks Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates	**15**	**CO1**
2	**MODULE II – Multilayer Perceptron** The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples-Radial-Basis Function Networks : Interpolation, Regularization	**15**	**CO2**
3	**MODULE III – Convolutional Neural Networks (CNN)** Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem and solution of under fitting and overfitting	**15**	**CO3**
4	**MODULE IV – Recurrent Neural Networks** Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architectures.	**15**	**CO4**
5	**MODULE V – Deep Learning applications** Image segmentation, Object detection, Attention model for computer vision tasks, Natural Language Processing, Speech Recognition, Video Analytics. Tools: Tensor Flow, Keras, PyTorch, Caffe, Theano, MXNet.	**15**	**CO5**

TEXT BOOKS:

1. Good fellow, I., Bengio,Y.,andCourville,A.,Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, OReilly,2017.

REFERENCE BOOKS:

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd,2009.
3. Golub, G., H., and VanLoan, C., F., Matrix Computations, JHUPress,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-HillEducation,2004.

E-REFERENCES:

1. https://medium.com/@bhatadithya54764118/day-43-introduction-to-neural-networks-biological-vs-artificial-networks-b8cd40d7df7d
2. https://github.com/ashishucsb/xor_back_propagation#:~:text=Solution,error%20by%20a%20small%20degree

FIFTH SEMESTER

MULTIDICIPLINARY ELECTIVE -MDE I

Course Title: MDE I- (A) ONLINE COMMERCE

Course Code : 2566526(A)	**Credits :03**
L:T:P:S : 4:1:0:0	**CIA Marks: 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To understand the foundations and importance of E-commerce*
- *To understand retailing in E-commerce by branding and pricing strategies and determining the effectiveness of market research*
- *To Implement the impact of E-commerce on business models and strategy*
- *To Assess the Internet trading relationships including Business to Consumer, Business-to- Business, Intra-organizational.*
- *To Know key features of the Internet, Intranets and Extranets and how they relate to each other.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate E-Commerce Frameworks. Distinguish E-Commerce and media Convergence Illustrate E-Commerce Applications.
CO2	Describe the E-Commerce Networks and Research Networks, Analyze Internet Commercialization.
CO3	Evaluate the E-Commerce how incorporates the Internet, Construct the Web Security.
CO4	Distinguish the different payment system. Illustrate the data interchange.
CO5	Understanding Advertising and Marketing on the Internet, Describe Software Agents

Mapping of Course Outcomes to Program Outcomes, Program Specific Outcomes:

CO/PO /PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	2	2	3	-	3	2	2	2	2	-
CO2	2	3	3	2	2	2	2	3	2	2	3	2
CO3	3	2	3	3	2	-	3	2	3	-	3	-
CO4	2	3	3	2	2	2	2	3	2	3	2	2
CO5	2	2	2	3	3	2	2	2	2	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE I: E-CommerceFramework** – E-Commerce and Media Convergence – The anatomy of E-commerce applications -E-Commerce Consumer Applications- E-Commerce Organization Applications.	**15**	**CO1**
2	**MODULE II: The Internet Terminology**– NSFNET–Architecture and Components–National Research and Education Network–Internet Governance–An Overview of Internet Applications. **The Business of Internet Commercialization**: Telco/Cable/Online Companies-National Independent ISPs –Regional level ISPs– Local level ISPs.	**15**	**CO2**
3	**MODULE III: E-Commerce and the World Wide Web**: Architectural Framework for E-commerce– WWW as the architecture–Technology behind the web–Security and the web.	**15**	**CO3**
4	**MODULE IV: Electronic Payment Systems**: Types of Electronic Payment Systems–Digital token Electronic Payment Systems–Credit Card Based Electronic Payment Systems–Risk and Electronic Payment Systems. **Electronic Data Interchange**: Legal, Security and Privacy issues.	**15**	**CO4**
5	**MODULE V: Advertising and Marketing on the Internet**: E-Commerce Catalogs–Information Filtering–Consumer Data Interface–Emerging tools. **Software Agents**: Characteristics and Properties of Software Agents–Technology behind Software Agents-Applets, Browsers, and Software Agents.	**15**	**CO5**

TEXT BOOK:

1. **Ravi Kalakota & Andrew Whinston,** "*Frontiers of Electronic-Commerce*", Addison Wesley.

REFERENCE BOOKS:

1. **Efraim Turvan J. Lee, David Kug and Chung**, "*Electronic Commerce*", Pearson Education, Asia.
2. **Manlyn Greenstein and Miklos**, "*Electronic Commerce*", TMH.

E-REFERENCES:

1. https://www.the-reference.com/en/expertise/creation-and.../e-commerce
2. https://en.wikipedia.org/wiki/E-commerce
3. https://www.tutorialspoint.com/e_commerce/index.htm

FIFTH SEMESTER

MULTIDICIPLINARY ELECTIVE -MDE I

Course Title: MDE I- (B)- DIGITAL MARKETING

Course Code : 2566526(B)	**Credits 03**
L:T:P:S : 4:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks 100**

Learning Objectives:

- *To make aware of digital Market interventions*
- *This course has been designed to keep in mind the requirement of industry in one end and competence enhancement on the other.*
- *To understand and initiate digital marketing.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Infer digital marketing practices, inclination of digital consumers and their behaviors.
CO2	Discover various search engine optimization techniques for digital marketing analysis.
CO3	Determine the value of integrated marketing campaigns across SEO, Paid Search, Social, Mobile, Email, Display Media, Marketing Analytics
CO4	Develop understanding of the latest digital practices for social media marketing and promotions
CO5	Distinguish between the different technology used in Digital Marketing. Construct insights on building organizational competency by way of digital marketing practices and cost considerations.

Mapping of Course Outcomes to Program Outcomes, Program Specific Outcomes:

CO/PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	3	3	2	3	2	2	-	3	2
CO2	3	3	3	2	2	-	3	3	2	2	3	-
CO3	3	2	3	2	3	2	3	3	3	2	3	2
CO4	2	3	2	3	3	3	2	3	2	3	2	3
CO5	2	2	2	3	3	3	3	2	3	2	2	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE I: Introduction to Digital Marketing**: What is digital marketing -Aligning the Internet with Business Objectives - User Behavior & Navigation.	**15**	**CO1**
2	**MODULE II: Search Engine Optimisation:** Stakeholders in Search - On & off- page Optimisation - Meta Tags, Layout, and Content updates Inbound Links & Link Building.	**15**	**CO2**
3	**MODULE III: Web Site Analytics:** Goal Configuration & Funnels - Intelligence Reporting - Conversions, Bounce Rate, Traffic Sources, Scheduling.	**15**	**CO3**
4	**MODULE IV: Social Media Marketing:** What is Social Media Marketing? -Overview of Facebook, Twitter, LinkedIn, Blogging, YouTube and Flickr - Building Brand Awareness Using Social Media.	**15**	**CO4**
5	**MODULE V: Digital Marketing Strategy:** Understanding strategy - Email Marketing - Affiliate marketing - Mobile Marketing - Display Advertising.	**15**	**CO5**

TEXT BOOK:

1. **Jerry Wind, Vijay Mahajan,** "*Digital Marketing: Global Strategies from the World's Leading Experts*".

REFERENCE BOOK:

1. **Kathryn Waite and Rodrigo Perez-Vega,** "*The Essentials of Digital Marketing".*

E-REFERENCES:

1. https://www.tutorialspoint.com/digital_marketing/index.htm
2. https://www.javatpoint.com/digital-marketing

FIFTH SEMESTER

MULTIDICIPLINARY ELECTIVE -MDE I

Course Title: MDE I- (C) SUPPLY CHAIN MANAGEMENT

Course Code : 2566526(C)	**Credits 03**
L: T: P: S : 4:1:0:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *To understand the scope and importance of supply chain management.*
- *To develop and apply critical thinking, problem-solving, and decision-making skills.*
- *To understand the role of IT in supply chain management.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate the evolution and importance of supply chain management, Distinguish Decision phase in supply chain. Illustrate supply chain applications.
CO2	Describe the Supply Chain Networks, Framework of supply chain and Role of network Design in supply chain.
CO3	Evaluate the Role of transportation in Supply Chain, Construct the transportation Network.
CO4	Distinguish sourcing and coordination in supply chain, Illustrate the effect of co-Ordination in supply chain and building strategies.
CO5	Understanding the role of IT in supply chain, Study of E-Business in supply chain.

Mapping of Course Outcomes to Program Outcomes, Program Specific Outcomes:

CO / PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	3	2	3	2	2	-	2	2
CO2	3	3	3	2	2	2	2	3	2	-	2	2
CO3	3	3	3	2	2	1	2	3	2	-	3	2
CO4	2	3	3	3	3	2	2	3	3	-	3	3
CO5	2	2	3	3	2	2	2	3	2	-	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE I: Introduction**: Role of Logistics and Supply Chain Management: Scope and Importance–Evolution of Supply Chain, Decision Phase in Supply Chain–Competitive and Supply chain strategies – Drivers of Supply Chain - Performance and Obstacles.	**15**	**CO1**
2	**MODULE II: Supply Chain Network Design:** Role of Distribution in Supply Chain–Factors influencing Distribution network design –Design options for Distribution Network – Role of Network Design in SupplyChain – Framework for network Decisions.	**15**	**CO2**
3	**MODULE III: Logistics in Supply Chain**: Role of Transportation in Supply Chain –Factors affecting transportation decision–Design options for transportation -Network-Tailored Transportation – Routing and Scheduling in transportation.	**15**	**CO3**
4	**MODULE IV: Sourcing and Coordination in Supply Chain**: Role of Sourcing supply chain supplier selection assessment and contracts –Design collaboration–sourcing planning and analysis–supply chain co-ordination – Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain	**15**	**CO4**
5	**MODULE V: Supply Chain and Information Technology**: The role IT in supply chain –The supply chain IT frame work Customer Relationship Management– Internal Supply Chain Management –Supplier Relationship Management –Future of IT in supply chain - E-Business in supply chain.	**15**	**CO5**

TEXT BOOK:

1. **Sunil Chopra, Peter Meindl and Kalra,** "*Supply Chain Management, Strategy, Planning, and Operation*", Pearson Education, 2010.

REFERENCE BOOKS:

1. **Jeremy F.Shapiro,** "*Modeling the Supply Chain*", 2002, Thomson Duxbury.
2. **Srinivasan G.S**, "*Quantitative models in Operations and Supply Chain Management*", 2010,PHI
3. **David J.Bloomberg , Stephen Lemay and Joe B.Hanna,** "*Logistics*", 2002, PHI .
4. **James B.Ayers,** "*Handbook of Supply Chain Management*", 2000, St.Lucle press.

E-REFERENCES:

1. https://ocw.mit.edu/courses/esd-273j-logistics-and-supply-chainmanagementfall- 2009/pages/lecture-notes/
2. https://onlinecourses.swayam2.ac.in/ugc19_hs51/preview
3. https://nptel.ac.in/courses/110106045

SIXTH SEMESTER

Course Title: CORE COURSE XIII –BIG DATA ANALYTICS WITH HADOOP AND NoSQL DATABASES

Course Code	**: 2566630**	**Credits**	**04**
L:T:P:S	**: 4:1:0:0**	**CIA Marks**	**: 50**
Exam Hours	**: 03**	**ESE Marks**	**: 100**

Learning Objectives:

- *Understand the Big Data Platform and its Use cases*
- *Provide an overview of Apache Hadoop*
- *Provide HDFS Concepts and Interfacing with HDFS*
- *Working with Tableau.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand Big Data and its analytics in the real world
CO2	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm
CO3	Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics
CO4	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics
CO5	Implement Big Data Activities using Hive

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No	Contents of Module	Hrs.	COs
1	**MODULE I: Big Data Introduction** Big Data introduction - definition and taxonomy - Big data value for the enterprise – The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data – Accessing HDFS through Java program.	**15**	**CO1**
2	**MODULE II: Map Reduce** Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem Chaining Map Reduce jobs	**15**	**CO2**
3	**MODULE III: Pig and Hive** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services– Hive QL– Querying Data in Hive - fundamentals of HBase and Zoo Keeper.	**15**	**CO3**
4	**MODULE IV: MongoDB** No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes-Mongo Import –Mongo Export.	**15**	**CO4**
5	**MODULE V: Cassandra** Introduction–Features - Datatypes–CQLSH-Key spaces-CRUD operations–Collections –Counter–TTL-Alter commands – Import and Export –Querying System tables.	**15**	**CO5**

TEXT BOOKS

1. J Seema Acharya,Subhashini Chellappan,"Big Data and Analytics", Wiley Publication,2015.
2. Ramesh Sharda, Dursun Delen, Efraim Turban (2018), Business Intelligence, Pearson Education Services Pvt Ltd.

REFERENCE BOOKS:

1. Judith Hurwitz, Alan Nugent, Dr.Fern Halper, Marcia Kaufman,"Big Data for Dummies", John Wiley & Sons, Inc., 2013.
2. Tom White, "Hadoop:The Definitive Guide",O"Reilly Publications,2011.
3. Kyle Banker, "MongoDB in Action", Manning Publications Company, 2012.
4. Russell Bradberry, Eric Blow, "Practical Cassandra A developersApproach",Pearson Education, 2014

E-REFERENCES:

1. https://www.edureka.co/blog/mapreduce-tutorial/
2. https://intellipaat.com/blog/tutorial/big-data-and-hadoop-tutorial/

SIXTH SEMESTER

Course Title: CORE COURSE XIV –IoT AND CLOUD TECHNOLOGIES WITH SECURITY AND PRIVACY MANAGEMENT

Course Code	**: 2566631**	**Credits**	**:04**
L:T:P:S	**: 4:1:0:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *Learn basic concepts of Cloud Computing.*
- *To get an overview of Map Reduce Concepts.*
- *To learn about infrastructure security, Data Security and Privacy.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Design an IoT system with cloud infrastructure.
CO2	Implement the M2M Communication protocols in a prototype
CO3	Understand the basic concepts of the main sensors used in electro mechanical systems
CO4	Understand/implement computer models of common engineering information types
CO5	Understand storage mechanisms/analysis algorithms for data management in distributed& data intensive applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs.	COs
1	**MODULE I: IoT Introduction** Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Sensors and Hardware for IoT – Hardware Platforms– Arduino, Raspberry Pi, Node MCU	**15**	**CO1**
2	**MODULE II: Introduction to Cloud Computing** Cloud Computing–Definition–SPI Framework–Software Model–Cloud Services Delivery Model – Deployment Models – Key drivers – Impact on Users	**15**	**CO2**
3	**MODULE III: Virtual Machines Provisioning and Migration Services** Introduction and Inspiration -Background and Related Work- Virtual Machines Provisioning and Manageability-Virtual Machine Migration Services- VM Provisioning and Migration in Action -Distributed Management of Virtual Infrastructures	**15**	**CO3**
4	**MODULE IV: Data Security, Identity and Access Management** Data security and storage: Aspects of Data Security -Data Security Mitigation -Provider Data and Its Security. Identity and Access Management: Trust Boundaries and IAM -Why IAM? - IAM Challenges- IAM Definitions- IAM Architecture IAM Practices in the Cloud	**15**	**CO4**
5	**MODULE V: Security and Privacy Security Management** Security Management: Standards–Security Management in the Cloud– Availability Management – Access Control. Privacy: What is Privacy – Data Life Cycle – Key Privacy Concerns–Who is responsible for protecting Privacy – Privacy Risk Management	**15**	**CO5**

TEXT BOOKS:

1. "The Internet of Things: Enabling Technologies, Platforms and Use Cases", by Pethuru Raj and Anupama C. Raman, CRC Press.
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. Tim Mather, Subra Kumaraswamy, Shahed Latif (2010), Cloud Security and Privacy, OREILLY Media.
4. Rajkumar Buyya, James Broberg, Andrzej Goscinski (2011), CLOUD COMPUTING Principles and Paradigms, John Wiley &Sons, Inc., Hoboken, New Jersey.

REFERENCE BOOKS:

1. RonaldL.Krutzand Russell Dean Vines(2010), Cloud Security, Wiley–India

E-REFERENCES:

1.https://www.geeksforgeeks.org/iot-and-cloud-computing/?utm_source=chatgpt.com

2.https://digitalcxo.com/article/integrating-iot-and-cloud-technologies-for-smarter-construction-operations/

SIXTH SEMESTER

Course Title: CORE COURSE XV -SOFTWARE ENGINEERING

Course Code	**: 2566632**	**Credits**	**:04**
L:T:P:S	**: 4:1:0:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *To introduce students to the core principles, methodologies, and practices in software engineering, providing a clear understanding of the software development life cycle (SDLC).*
- *To enable students to gather, analyze, document, and validate software requirements effectively, distinguishing between functional and non-functional requirements.*
- *To provide students with the knowledge of design methodologies and architectural patterns, empowering them to design robust, scalable, and maintainable software systems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate an understanding of the key principles of software engineering and its importance in system design.
CO2	Collect, analyze, and document both functional and non-functional software requirements, ensuring clarity and accuracy in the software specification.
CO3	Apply design methodologies such as object-oriented design and structured design, and create UML diagrams and software architecture patterns for developing efficient software systems.
CO4	Design and execute test cases for various testing levels, use test automation tools, and apply software quality metrics to ensure software quality.
CO5	Apply project management tools and techniques to manage software projects, including effort estimation, scheduling, risk management, and version control, and understand the principles of software maintenance and DevOps

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO /PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	3	3	3	3	3	2	2
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**MODULE I: Introduction to Software Engineering** Definition of Software Engineering – Software Development Life Cycle (SDLC) Models: Waterfall, Iterative, Spiral, Agile – Principles of Software Engineering – Software Process and Process Models – Importance of Software Engineering in System Design – Case Study: Comparative Analysis of SDLC Models.	**15**	**CO1**
2	**MODULE II: Software Requirements and Analysis** Requirements Engineering: Elicitation, Analysis, and Documentation – Functional and Non-Functional Requirements – Use Case Modeling – Software Requirement Specification (SRS) – Feasibility Studies – Requirements Validation Techniques – Tools for Requirement Analysis.	**15**	**CO2**
3	**MODULE III: Software Design and Architecture** Introduction to Software Design: Principles and Concepts – Design Methodologies: Structured Design, Object-Oriented Design – Unified Modeling Language (UML) Diagrams: Class, Sequence, Use Case, Activity – Software Architecture Patterns: Layered, MVC, Microservices – Design Documentation and Best Practices – Case Study: Software Design for Large-Scale Applications.	**15**	**CO3**
4	**MODULE IV: Software Testing and Quality Assurance** Levels of Testing: MODULE Testing, Integration Testing, System Testing, Acceptance Testing – Black Box and White Box Testing Techniques – Test Case Design and Documentation – Introduction to Test Automation Tools – Software Quality Assurance (SQA): Concepts and Practices – Metrics for Software Quality – Continuous Integration and Delivery (CI/CD).	**15**	**CO4**
5	**MODULE V: Software Project Management and Maintenance** Software Project Planning: Effort Estimation Techniques (COCOMO, Function Points) – Scheduling and Resource Allocation – Risk Management in Software Projects – Software Maintenance: Corrective, Adaptive, Perfective, Preventive – Change Management and Version Control – Overview of DevOps in Software Engineering – Case Study: Project Management Tools and Techniques.	**15**	**CO5**

TEXT BOOKS:

1. Ian Sommerville, "Software Engineering," Pearson Education, 10th Edition, 2015.
2. Roger S. Pressman, "Software Engineering: A Practitioner's Approach," McGraw Hill, 8th Edition, 2014.
3. Shari Lawrence Pfleeger, "Software Engineering: Theory and Practice," Pearson Education, 4th Edition, 2010.

REFERENCE BOOKS:

1. Pankaj Jalote, "An Integrated Approach to Software Engineering," Springer, 3rd Edition, 2011.
2. Hans Van Vliet, "Software Engineering: Principles and Practice," Wiley, 3rd Edition, 2008.

E-REFERENCES

1. http://www.geeksforgeeks.org/software-engineering/

SIXTH SEMESTER

Course title: CORE PRACTICAL VIII –BIG DATA ANALYTICS LAB

Course Code	**: 2566633**	**Credits**	**:02**
L:T:P:S	**: 0:1:3:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- *Gain hands-on experience with tools and technologies like Hadoop, Spark, and NoSQL databases to process and analyze large-scale datasets.*
- *Learn to design and implement efficient data pipelines for managing, cleaning, and transforming massive volumes of data from multiple sources.*
- *Apply statistical and machine learning techniques to derive meaningful insights from big data, focusing on pattern recognition, predictive analytics, and trend forecasting.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand and operate on HDFS using basic shell commands and Java API.
CO2	Develop and execute basic to intermediate MapReduce programs in Java using Eclipse.
CO3	Analyze and solve real-world data problems using MapReduce techniques.
CO4	Implement relational operations and analytical queries using Pig and Hive.
CO5	Apply Hadoop ecosystem tools to perform end-to-end big data processing tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**3**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**Introduction to HDFS and Java-Based File Operations** a. Basic HDFS commands: load, retrieve, mkdir, rm, ls b. HDFS Java API: read/write files, directory operations	**9**	**CO1**
2	**MapReduce Programming Basics with Java and Eclipse** a. Java programs for HDFS interaction b. Word Count MapReduce using Eclipse	**9**	**CO2**
3	**Problem Solving Using MapReduce Algorithms** a. Matrix multiplication using one MapReduce step b. Word sort using MapReduce c. Max temperature and max salary problems using MapReduce d. Student grading system using MapReduce	**9**	**CO3**
4	**Data Querying and Processing Using Pig and Hive** a. Relational algorithms on Pig (joins, filters, etc.) b. Database operations on Hive (DDL, DML, querying)	**9**	**CO4**
5	**Advanced Data Analytics Using MapReduce** a. Log file analysis using MapReduce b. Frequent Item Set algorithm using MapReduce	**9**	**CO5**

REFERENCE BOOKS

1. MapReduce Design Patterns, Donald Miner, Adam Shook, O'Reilly Media
2. Data-Intensive Text Processing with MapReduce, Jimmy Lin, Chris Dyer, Morgan & Claypool Publishers
3. Hadoop in Practice, Alex Holmes, Manning Publications

SIXTH SEMESTER

Course Title: CORE PRACTICAL IX- IoT AND CLOUD COMPUTING LAB

Course Code : 2566634	**Credits :02**
L:T:P:S : 0:1:3:0	**CIA Marks : 50**
Exam Hours : 03	**ESE Marks : 100**

Learning Objectives:

- *Understand and implement various IoT communication protocols like MQTT, CoAP, and HTTP for seamless data transmission between devices and cloud platforms.*
- *Learn how to integrate IoT devices with cloud platforms (e.g., AWS IoT, Microsoft Azure, Google Cloud) to enable data storage, processing, and remote monitoring.*
- *Implement cloud-based data storage and processing solutions for handling large volumes of IoT-generated data, and apply analytics to extract valuable insights from it.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Interface and control basic electronic components such as LEDs, push buttons, buzzers, and sensors using microcontrollers like Arduino, NodeMCU, and Raspberry Pi.
CO2	Collect and display environmental data using sensors (e.g., DHT11, PIR) and microcontrollers.
CO3	Display sensor or system data using LCD or RGB LED on microcontroller platforms.
CO4	Build wireless IoT applications using NodeMCU and mobile apps for remote control.
CO5	Install, configure, and migrate virtual machines using modern virtualization platforms.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	1	2	2	2	3	3	3	3	2
CO2	3	3	3	1	2	2	2	3	3	3	3	3
CO3	3	3	3	1	2	2	2	3	3	3	3	3
CO4	3	3	3	1	1	3	2	2	2	2	3	3
CO5	3	2	3	1	2	3	2	2	2	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

Sl. No.	Contents of Module	Hrs.	COs
1	**Basic GPIO Interfacing with Arduino/ Raspberry Pi** a) Interface LED – Blinking LED b) Interfacing Push Button and LED c) LED blinking when button is pressed	**9**	**CO1**
2	**Sensor-Based Applications and Environmental Monitoring** a) Interfacing a DHT11 sensor with Arduino/Raspberry Pi b) Display temperature and humidity c) Interfacing temperature sensor with Arduino d) Interfacing Active Buzzer / Light Theremin e) Detect motion using a PIR sensor with Raspberry Pi and print a message	**9**	**CO2**
3	**Visual Output Using LCD and RGB LED Interfaces** a) Interfacing LCD – display print statement data b) Interfacing RGB LED with Arduino	**9**	**CO3**
4	**IoT Control Using NodeMCU and Mobile App Integration** An LED using NodeMCU and mobile app over Wi-Fi	**9**	**CO4**
5	**Virtual Machine Setup and Migration Techniques** a) Set up a VM with custom OS in VMware/VirtualBox b) Allocate CPU, memory, storage c) Perform live or cold migration of a virtual machine	**9**	**CO5**

REFERENCE BOOKS

1. **"Exploring Arduino: Tools and Techniques for Engineering Wizardry",** Author: Jeremy Blum, Publisher: Wiley
2. "Make: Sensors: A Hands-On Primer for Monitoring the Real World with Arduino and Raspberry Pi", Author: Tero Karvinen, Kimmo Karvinen, Ville Valtokari, Publisher: Maker Media, Inc.
3. "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", Author: Simon Monk, Publisher: O'Reilly Media

SIXTH SEMESTER

Course Title: CORE PRACTICAL X - PROGRAMMING IN UI PATH AUTOMATION LAB

Course Code	**: 2566635**	**Credits**	**:02**
L:T:P:S	**: 0:1:3:0**	**CIA Marks**	**:50**
Exam Hours	**: 03**	**ESE Marks**	**:100**

Learning Objectives:

- ***Introduce Robotic Process Automation (RPA)****: Provide students with a fundamental understanding of RPA concepts, its applications, and the role of automation in various business processes.*
- ***Hands-on Experience with UI Path****: Equip students with the skills to use UI Path Studio to design, implement, and debug automation workflows for real-world applications.*
- ***Develop Automation Solutions****: Enable students to create automated processes that interact with different applications (web, desktop, and legacy systems), focusing on tasks such as data extraction, validation, data manipulation, and reporting.*
- ***UI Path Scripting and Debugging****: Teach students how to use UI Path's scripting language, debugging tools, and best practices to optimize automation workflows.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Apply UI/UX design principles to develop intuitive and visually appealing user interfaces.
CO2	Design user-centric forms and interaction flows for mobile and web apps.
CO3	Create structured layout designs for product, profile, and detail pages with usability in focus.
CO4	Build dashboards and settings interfaces with emphasis on information hierarchy and accessibility.
CO5	Use prototyping tools to present interactive mockups and gather user feedback effectively.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/ PO/ PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	3	1	2	2	2	3	3	3	3	2
CO2	3	3	3	1	2	2	2	3	3	3	3	3
CO3	3	3	3	1	2	2	2	3	3	3	3	3
CO4	3	3	3	1	1	3	2	2	2	2	3	3
CO5	3	2	3	1	2	3	2	2	2	2	3	3

CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW

S.No.	Contents of Module	Hrs	COs
1	**Fundamentals of UI Design: Entry Points and Product Pages** a) Design a clean and modern login screen with email, password, "Forgot Password?" and login button b) Create a landing page with hero section, features, testimonials, and call-to-action c) Design a product detail page for e-commerce with images, price, reviews, and "Add to Cart"	**9**	**CO1**
2	**Interactive Form Design for Event-Based Applications** a) Design an RSVP page for an event with details, form, and meal preferences	**9**	**CO2**
3	**User-Centric Content Design for Social and Lifestyle Apps** a) Create a user profile page with bio, posts, followers, and edit profile option b) Create a recipe detail page with ingredients, cooking steps, and ratings	**9**	**CO3**
4	**Designing Settings and Data-Driven Dashboards** a) Create a settings page with notification, privacy, account, and logout options b) Design a dashboard with charts, stats, and navigation to other app sections	**9**	**CO4**
5	**User Onboarding and Feedback Capture Interfaces** a) Design onboarding screens using illustrations and concise texts b) Create a simple feedback form with name, email, type, and comment box	**9**	**CO5**

REFERENCE BOOKS

1. Alan Cooper, Robert Reimann – About Face: The Essentials of Interaction Design, Wiley

2. Joel Marsh – UX for Beginners, O'Reilly Media'

SIXTH SEMESTER

Course Title: Core Project - PROJECT WORK

Course Code: 2566636	**Credits : 02**
L: T: P: S : 0:1:2:0	**CIA Marks : 50**
Exam Hours: 03	**ESE Marks : 100**

Learning Objectives:

- *Implement the solution for the chosen problem using the concepts and the techniques learnt in the curriculum.*
- *Develop software applications*
- *Record the research results for a given problem*
- *Identify, formulate and implement computing solutions.*
- *Design and conduct experiments, analyze and interpret data.*
- *Analyze a system, component or process as per needs and specification.*
- *Work on multidisciplinary tasks and will be aware of the new and emerging disciplines.*
- *Demonstrate skills to use modern tools, software and equipment to analyze problems.*

Procedure:

- The Head of the Department will assign an Internal Guide for each student.
- During regular intervals, student should report about his/her progress of the project work.
- After the submission of the final report, an external examiner will evaluate the project document and conduct the viva voce examination.

APPENDIX

OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery and assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance, i.e. outcomes at different levels.

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE, instead, classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation.

Program Educational Objectives (PEOs)

The Programme Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and what the graduates are expected to perform and achieve during the first few years after graduation.

Programme Outcomes (POs)

Program outcomes are finer statements that designate what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

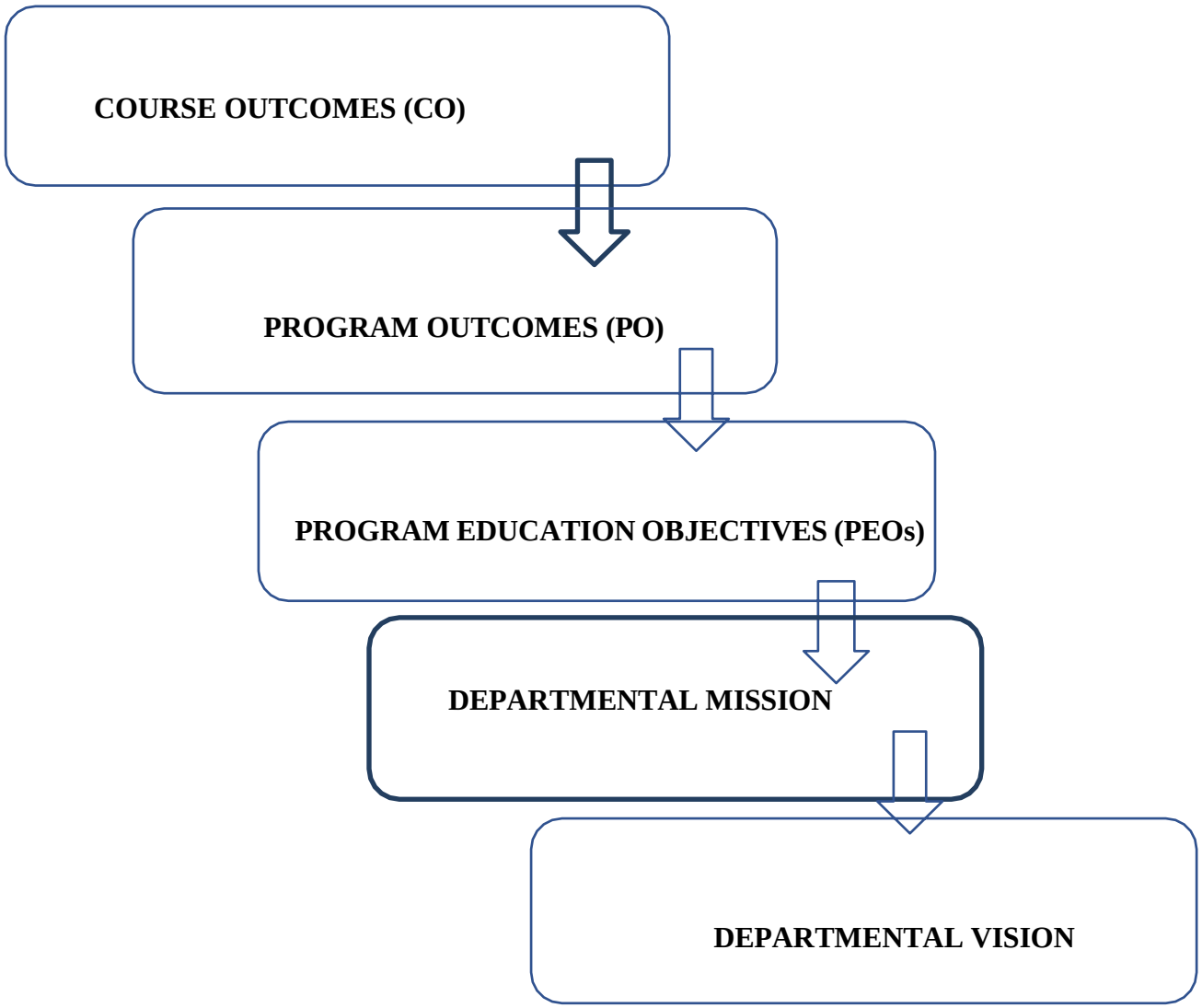
Programme Specific Outcomes (PSO)

Programme Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline.

Course Outcome (CO)

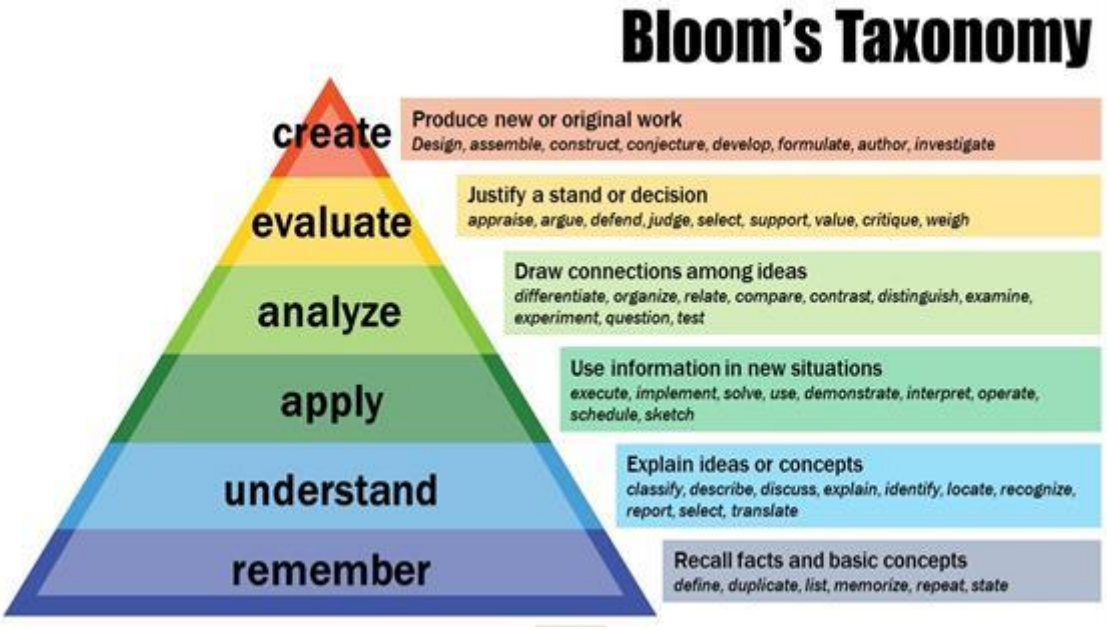
Course outcomes are statements that describe significant and essential learning that learners have achieved and can reliably demonstrate at the end of a course.

MAPPING OF OUTCOMES



BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition, i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (MODULEs, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]



Knowledge levels for assessment of Outcomes based on Bloom's Taxonomy

LEVEL	PARAMETER	DESCRIPTION
K1	**Knowledge**	It is the ability to remember previously learned material/information
K2	**Comprehension**	It is the ability to grasp the meaning of material
K3	**Application**	It is the ability to use learned material in new and concrete situations
K4	**Analysis**	It is the ability to break down material/concept into its component parts/subsections so that its organizational structure may be understood
K5	**Synthesis**	It is the ability to put parts/subsections together to form a new whole material/idea/concept/information
K6	**Evaluation**	It is the ability to judge the value of material/concept/statement/creative material /research report for a given purpose