



MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A unit of Rajalaxmi Education Trust ®, Mangalore)

Autonomous Institute Affiliated to V.T.U., Belagavi , Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

**SCHEME & SYLLABUS
I/II/III/IV SEMESTER
MCA PROGRAM**

**2024 Scheme
(W.E.F 2024 Admission Students)**



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Institute Vision

“To attain perfection in providing Globally Competitive Quality Education to all our Students and also benefit the global community by using our strength in Research and Development”

Institute Mission

“To establish world class educational institutions in their respective domains, which shall be Centers of Excellence in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming Visionary and Realistic, Sensitive and Demanding, Innovative and Practical, Theoretical and Pragmatic; ALL at the same time”

Department Vision

To attain global recognition as a leader in imparting quality education in the field of computer applications by fostering an inclusive and dynamic learning environment that nurtures research skills, creativity, innovation, and critical thinking ability of the students.

Department Mission

- To deliver modern multi-disciplinary technological skills in the field of computer applications.*
- To cultivate a research culture among the faculty and students to the betterment of the human society at large.*
- To make students cognizant of the importance of ethical and moral values while creating futuristic software applications.*

Program Educational Objectives (PEOs)

- Design effective computing systems that are technically viable and fulfilling the requirements of customers.*
- Develop a professional career to contribute towards interdisciplinary academic and research projects.*
- Acquire and apply the knowledge of existing tools and technologies from time to time to industry-oriented and societal problems.*

Program Specific Outcomes (PSOs)

- Apply the principles of Software Engineering and Project management to design, develop and maintain software applications using Programming languages and frameworks.*
- Apply computational techniques and algorithms to solve real-world problems in artificial intelligence and cybersecurity environments.*

LIST OF COURSES

I/II/III/IV SEMESTER

Sl. No	Course Code	Course Title	Sem
PROFESSIONAL CORE (PC)			
1	24MCPC511	Mathematical Foundation for Computer Applications	I
2	24MCPC512	Problem Solving and Programming in Python	I
3	24MCPC513	Operating System	I
4	24MCPC514	Data Structures	I
5	24MCPC515	Computer Networks	I
6	24MCPC516	Software Engineering	I
7	24MCPC517	Web Technologies	I
8	24MCPC521	Design and Analysis of Algorithms	II
9	24MCPC522	Programming in Java	II
10	24MCPC523	Database Management Systems	II
11	24MCPC524	Object Oriented Modeling and Design	II
12	24MCPC611	Cloud Computing	III
13	24MCPC612	Advanced Java	III
PROFESSIONAL ELECTIVE (PE)			
14	24MCPE551	Cryptography and Cyber Security	II
15	24MCPE552	Network Security	II
16	24MCPE553	Machine Learning	II
17	24MCPE554	Natural Language Processing	II
18	24MCPE651	Ethical Hacking	III
19	24MCPE652	Digital Forensics	III
20	24MCPE653	Deep Learning	III
21	24MCPE654	Pattern Recognition	III
22	24MCPE661	Secure Software Development	III
23	24MCPE662	Blockchain Technology	III
24	24MCPE663	Computer Vision	III
25	24MCPE664	Applications of Machine Learning for Image and Video Analytics	III
HUMANITIES (HM)			
26	24MCHM525	Research Methodology & IPR	II
SKILL ENHANCEMENT (SE)			
27	24MCSE526	Mini Project	II
28	24MCSE613	Major Project Phase - 1	III
29	24MCSE614	Internship	III
30	24MCSE621	Major Project Phase - 2	IV
31	24MCSE622	MOOC Course	IV
AUDIT COURSE(AU)			
32	24MCNM518	Professional Communication and Ethics	I



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I SEMESTER

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours / Week			Exam Marks			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPC511	Mathematical Foundation for Computer Applications	Professional Core	Mathematics	2	2	0	50	50	100	3	3
2	24MCPC512	Problem Solving and Programming in Python	Professional Core	MCA	2	0	2	50	50	100	3	3
3	24MCPC513	Operating System	Professional Core	MCA	3	0	0	50	50	100	3	3
4	24MCPC514	Data Structures	Professional Core	MCA	2	0	2	50	50	100	3	3
5	24MCPC515	Computer Networks	Professional Core	MCA	3	0	0	50	50	100	3	3
6	24MCPC516	Software Engineering	Professional Core	MCA	3	0	0	50	50	100	3	3
7	24MCPC517	Web Technologies	Professional Core	MCA	2	0	2	50	50	100	3	3
8	24MCNM518	Professional Communication and Ethics	*NM	MCA	1	1	0	-	-	-	-	-
Total											21	

*NM – No Credit Mandatory Course



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II SEMESTER

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPC521	Design and Analysis of Algorithms	Professional Core	MCA	4	0	0	50	50	100	3	4
2	24MCPC522	Programming in Java	Professional Core	MCA	3	0	2	50	50	100	3	4
3	24MCPC523	Database Management Systems	Professional Core	MCA	2	0	2	50	50	100	3	3
4	24MCPC524	Object Oriented Modeling and Design	Professional Core	MCA	2	0	2	50	50	100	3	3
5	24MCHM525	Research Methodology & IPR	Humanities	MCA	1	0	2*	50	50	100	2.5	2
6	24MCPE55X	Professional Elective - 1	Professional Elective	MCA	**-	**-	**-	50	50	100	3	3
7	24MCSE526	Mini Project	Skill Enhancement	MCA	-	-	2	50	50	100	2.5	1
Total Credits											20	

*Self-learning **Professional Elective-based structure

Professional Elective – 1

Stream I – Cyber Security

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Exam Marks			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE551	Cryptography and Cybersecurity	Professional Elective	MCA	3	0	0	50	50	100	3	3
2	24MCPE552	Network Security	Professional Elective	MCA	3	0	0	50	50	100	3	3

Stream II - AI & ML

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Exam Marks			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE553	Machine Learning	Professional Elective	MCA	2	0	2	50	50	100	3	3
2	24MCPE554	Natural Language Processing	Professional Elective	MCA	2	0	2	50	50	100	3	3



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III SEMESTER

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPC611	Cloud Computing	Professional Core	MCA	3	0	0	50	50	100	3	3
2	24MCPC612	Advanced Java	Professional Core	MCA	3	0	2	50	50	100	3	4
3	24MCPE65X	Professional Elective - 2	Professional Elective	MCA	*-	*-	*-	50	50	100	3	3
4	24MCPE66X	Professional Elective - 3	Professional Elective	MCA	*-	*-	*-	50	50	100	3	3
5	24MCSE613	Major Project Phase - 1	Skill Enhancement	MCA	-	-	-	100	-	100	-	5
6	24MCSE614	Internship	Skill Enhancement	-	10 weeks internship completed during the intervening vacation of II & III Semester			50	50	100	3	5
Total Credits												23

*Professional Elective-based structure

Professional Elective – 2

Stream I – Cyber Security

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE651	Ethical Hacking	PE	MCA	2	0	2	50	50	100	3	3
2	24MCPE652	Digital Forensics	PE	MCA	3	0	0	50	50	100	3	3

Stream II - AI & ML

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE653	Deep Learning	PE	MCA	2	0	2	50	50	100	3	3
2	24MCPE654	Pattern Recognition	PE	MCA	2	0	2	50	50	100	3	3

Professional Elective – 3

Stream I – Cyber Security

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE661	Secure Software Development	PE	MCA	3	0	0	50	50	100	3	3
2	24MCPE662	Blockchain Technology	PE	MCA	2	0	2	50	50	100	3	3

Stream II - AI & ML

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCPE663	Computer Vision	PE	MCA	2	0	2	50	50	100	3	3
2	24MCPE664	Applications of Machine Learning for Image and Video Analytics	PE	MCA	2	0	2	50	50	100	3	3

IV SEMESTER

Sl. No	Course Code	Course Title	Category	Teaching Dept	Teaching Hours / Week			Examination (Marks)			Duration of Exam (SEE)	Credits
					L	T	P	CIE	SEE	Total		
1	24MCSE621	Major Project Phase -2	Skill Enhancement	-	-	-	-	100	100	200	3	14
2	24MCSE622	MOOC Course**	Skill Enhancement	Online	-	-	-	-	-	-	-	2
Total Credits											16	

**Mandatory NPTEL Course



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I SEM

MATHEMATICAL FOUNDATION FOR COMPUTER APPLICATIONS

Semester	I	CIE Marks	50
Course Code	24MCPC511	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:2:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Lay strong foundation of Sets, Relations and Functions to perform competent operations associated with them.
2. Impart knowledge of Mathematical logic empowering students to proficiently solve a variety of logical problems.
3. Introduce the basic principles of Graph theory and develop the ability to analyze graphs by exploring their properties.
4. Compute and interpret correlation coefficients to measure the relationship between two variables and apply simple linear regression to predict one variable based on another.
5. Build a strong foundation in probability theory to solve problems involving random phenomena.

Module 1: Sets, Relations and Functions

No. of Hrs: 08

Basics of set theory, Cartesian product of sets, Relations and their properties, Relation matrix & Digraph of relations, Equivalence relations & Partitions.

Functions- Types of functions, Function composition, Applications of sets, relations to solve simple real-life problems.

Introduction to mathematical computation using MATLAB.

Self-study: Representing sets, performing set operations, and investigating Relation matrix using MATLAB.

Textbook 1 - Ch 2

Pedagogy	Chalk-talk, ppt
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Module 2: Mathematical logic

No. of Hrs: 10

Basic connectivity and Truth table, Logical equivalences, Predicative Logic, Rules of inference, Quantifiers

Self-study: Performing logical operations using MATLAB.

Textbook 1 - Ch 1

Pedagogy	Chalk-talk, ppt
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Module 3: Graph theory

No. of Hrs: 08

Graphs & graph models, Subgraphs, Complement and Graph Isomorphism, Connectivity, Euler's & Hamiltonian paths, Graph theory applications in solving real-life problems.

Self-study: Representing graphs, and determining its combinatorial properties using MATLAB

Textbook 1 - Ch 9

Pedagogy	Chalk-talk, ppt
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Module 4: Correlation & Regression

No. of Hrs: 08

Curve fitting by the method of least squares, fitting of curves – Polynomial and Exponential. Correlation and Linear regression, Applications of Curve fitting and Linear Regression in addressing real-life problems.



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Self-study: Computing correlation coefficient, fitting of curves using MATLAB.

Textbook 2 - Ch 11

Pedagogy	Chalk-talk, ppt
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Module 5: Probability	No. of Hrs: 08
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Basic concepts of probability, properties of probability, Conditional probability, Bayes' theorem, Application of probability in solving real-life problems.

Self-study: Computing conditional probability, expectation and variance using MATLAB

Textbook 2 - Ch 2

Pedagogy	Chalk-talk, ppt
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Course Outcomes:

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

CO1: Illustrate the concepts of Sets, Relations & Functions, Mathematical logic, Graph theory, Statistics and Probability

CO2: Apply the concepts of Sets, Relations & Functions, Mathematical logic, Graph theory, Statistics and Probability to solve related problems.

CO3: Solve real-life problems based on the concepts of Sets, Relations & Functions, Mathematical logic, Graph theory, Statistics and Probability.

CO4: Use MATLAB to perform mathematical computations related to sets, relations and functions, Mathematical logic, curve fitting, linear regression, graphs in MATLAB.

Textbooks:

1. Kenneth H Rosen, “Discrete Mathematics and its Applications”, 8th Edition, Tata McGraw-Hill Education Private Limited, 2023
2. Ronald E. Walpole, Sharon L Myers, “Probability and Statistics for engineers and Scientist”, 9th Edition, Pearson Education, 2022

Reference Books:

1. Sheldon Ross, “A First Course in Probability”, 10th Edition, Pearson, 2023
2. J.K Sharma, “Discrete Mathematics”, 4th Edition, Mac Millian Publishers India, 2018
3. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Process”, 2nd Edition, Elsevier Academic Press, 2023

Web Links:

1. Introduction to theory of Sets-<https://nptel.ac.in/courses/111107058>
2. Mathematical Logics-https://onlinecourses.nptel.ac.in/noc20_cs82/preview
3. Introduction: Regression Analysis-[NPTEL :: Mathematics - Regression Analysis](#)



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Invent Solutions

PROBLEM SOLVING AND PROGRAMMING IN PYTHON

Semester	I	CIE Marks	50
Course Code	24MCPC512	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Impart knowledge on the different collection objects and functions in Python.
2. Provide skills to use object-oriented programming constructs using Python.
3. Develop skills to use NumPy array functionalities and pandas data structures for data analysis.
4. Realize data visualization skills using Matplotlib and Seaborn libraries.

Module 1: Python Basic Concepts and Programming	No. of Hrs: 06+06
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Using Python Interpreter, Introduction to Python, Running Python, The First Program, Arithmetic Operators, Values and Types, Formal and Natural Languages, Variables, Expressions and Statements, Functions, Conditionals and Recursion, Fruitful functions, Iteration, More Control Flow tools.

Textbook 2 – Ch 2, 3, 4

Textbook 1 – Ch 1, 2, 3, 4, 5, 6, 7

Laboratory Components:

Programs should be written and executed for the following:

1. Performing a linear search on a given dataset
2. Insertion of an element into a sorted list.
3. Use Object Oriented programming to show encapsulation, overloading and inheritance.

Module 2: Python Collection Objects, Classes	No. of Hrs:05+06
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Strings, Lists, Dictionaries, Tuples, Files, Classes and Objects, Classes and Functions, Classes and Methods, Inheritance.

Textbook 1 – Ch 8, 10, 11, 12, 14, 15, 16, 17, 18

Textbook 2 – Ch 5, 9

Laboratory Components:

4. Use pandas to perform a) Importing Datasets b) Cleaning the Data c) Data frame manipulation
5. Use NumPy to perform a) Array Manipulation, Searching, Sorting and Splitting b) Broadcasting and Plotting NumPy arrays.
6. Use NumPy and Matplotlib for data visualization of various types of graphs.

Module 3: Introduction to NumPy and pandas	No. of Hrs: 05+06
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Numpy: Understanding datatypes in Python, Basics of NumPy arrays, Computation on NumPy arrays: Universal Function.

Pandas: Introduction to pandas Data Structure, Essential Functionally, Summarizing and Computing



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Descriptive Statistics, Handling Missing Data.

Textbook 3 – Ch 2, 3

Laboratory Components:

7. Use NumPy to create an $m \times n$ integer array, print its attributes and use Matplotlib to visualize it
Generate a) Linear regression models b) Logistic regression models.

Module 4: Data Loading and Data Wrangling

No. of Hrs: 05+06

Reading and Writing data in text format, Interacting with the Database, Combining and Merging datasets, Reshaping and Pivoting, Data Transformation, String Manipulation.

Textbook 3 – Ch 3

Laboratory Components:

8. Time Series analysis with pandas.
9. Data visualization using Seaborn

Module 5: Visualization with Matplotlib and Seaborn

No. of Hrs: 05

General Matplotlib tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binning and Density, Customizing Plot Legends and Color Bars, Customizing Matplotlib, Visualization with Seaborn.

Textbook 3 – Ch 4

Course Outcomes:

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

CO1: Use Python programming concepts like flow control and decision-making constructs to solve problems.

CO2: Utilize the concepts of lists, dictionaries and strings and its associated functions in Python programs to write programs for a given problem definition.

CO3: Make use of NumPy array functionalities and pandas framework for data manipulations.

CO4: Apply the data transformation techniques on different datasets and arrive at data-driven insights.

CO5: Utilize data visualization tools such as Matplotlib, Seaborn to create various types of data visualizations.

Textbooks:

1. Allen B. Downey, “*Think Python: How to Think Like a Computer Scientist*”, 2nd Edition, Shroff/O'Reilly Publishers, 2016
2. Guido Van Rossum, Fred L. Drake Jr, “*An Introduction to Python*”, Network Theory Ltd, 2011
3. Jake Vander Plas, “*Python Data Science Handbook: Essential tools for Working with Data*”, 1st Edition, O'Reilly Publishers, 2016



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Reference Books:

1. Mark Lutz, "Programming Python: Powerful Object-Oriented Programming", 4th Edition, Shroff/O'Reilly Publishers, 2011
2. Tim Hall, J-P Stacey, "Python 3 for Absolute Beginners", 1st Edition, Apress, 2009
3. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", 2nd Edition, Apress, 2009
4. Shai Vaingast, "Beginning Python Visualization: Crafting Visual Transformation Scripts", 1st Edition, Apress, 2009

Web Links:

1. Programming in Python: https://onlinecourses.swayam2.ac.in/cec24_cs11/preview
2. Python for Data Science: https://onlinecourses.nptel.ac.in/noc24_cs68/preview
3. Python for Everybody: <https://www.coursera.org/specializations/python>

OPERATING SYSTEM

Semester	I	CIE Marks	50
Course Code	24MCPC513	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Familiarize the basic concepts and structure of operating systems.
2. Impart knowledge on different process scheduling techniques.
3. Familiarize with the basics of process management, deadlocks and file systems.
4. Provide skills on using the Unix commands on the Unix/Linux operating system.
5. Impart the basic knowledge of shell programming on the Unix operating system.

Module 1: Introduction	No. of Hrs: 08
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Overview: Introduction to Operating Systems, Computer System Architecture, Operating System Operations, Distributed Systems, Open-source operating systems.

System Structures: Operating System Services, System Calls, Types of System Calls, System Services, Operating System Structure, Virtualization.

Textbook 1 - Ch 1, 2

Module 2: Process Management	No. of Hrs: 08
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Process Management: Process concept, process state, process control block, Process Scheduling: Basic concepts, Scheduling criteria, Scheduling Algorithms: FCFS, SJFS, Priority scheduling, Round Robin Scheduling. **Multithreaded Programming:** Overview, Multithreaded Models, Threading Issues.

Textbook 1 - Ch 3, 4, 5

Module 3: Synchronization and Deadlocks	No. of Hrs: 08
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Process Synchronization: Critical section problem, Peterson's Solution, Synchronization hardware, Semaphore, Classic problems of synchronization, Monitors.

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

Textbook 1 - Ch 6, 7, 8

Module 4: The File System	No. of Hrs: 09
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The File System: The File & File name, Unix File System, The Parent-Child Relationship, The HOME Variable: The Home Directory, pwd, cd, mkdir, rmdir, Absolute Pathnames, Relative Pathnames.

Basic File Attributes: ls options, File Ownership, File Permissions, chmod, Directory Permissions, Changing the File Ownership

More File Attributes: File Systems and Inodes, Hard Links, Symbolic Links, The Directory, umask, Modification and Access Times, find.

Textbook 2 - Ch 5, 6, 11

Module 5: Shell Programming	No. of Hrs: 09
<p>The Shell: The Shell's Interpretive Cycle, Shell Offerings, Pattern Matching-The Wild-cards, Escaping and Quoting, Redirection: The Three Standard Files, Two Special Files: /dev/null and /dev/tty, pipes, tee: Creating a Tee, Command Substitution.</p> <p>Essential Shell Programming: Shell Variables, Environment Variables, Shell Scripts, read, Using Command Line Arguments, exit and exit status of command, The Logical Operators, The if Conditional, using test and [] to Evaluate Expression, The case Conditional, expr, while: looping, for: looping with a list, set and shift.</p>	
<p>Textbook 2 - Ch 8, 14</p>	
<p>Course Outcomes:</p> <p>At the end of the course, the student will be able to:</p> <p>CO1: Outline the components in a typical operating system structure and use functions, system calls to perform different operations.</p> <p>CO2: Utilize the different scheduling algorithms and solve problems in concurrency and deadlock management.</p> <p>CO3: Summarize the different process synchronization problems and handling threads in a multithreaded environment.</p> <p>CO4: Identify the appropriate Linux commands for memory management, file management, and directory management tasks.</p> <p>CO5: Develop shell scripts to automate routine tasks and manage system operations effectively.</p>	
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “<i>Operating Systems Concepts</i>”, 10th Edition, Wiley India, 2018. 2. Sumitabha Das, “<i>UNIX Concepts and Applications</i>”, 4th Edition, Tata McGraw Hill, 2006. 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. D. M. Dhamdhere, “<i>Operating Systems – A Concept Based Approach</i>”, 2nd Edition, Tata McGraw – Hill, 2006 2. P. C. P. Bhatt, “<i>Operating Systems</i>”, 2nd Edition, PHI, 2006 3. W. Richard Stevens Stephen A. Rago, “<i>Advanced Programming in the UNIX Environment</i>”, 3rd Edition, Addison Wesley, 2013 	
<p>Web Links:</p> <ol style="list-style-type: none"> 1. Operating Systems Fundamentals: https://www.coursera.org/learn/akamai-operating-systems 2. Operating System: https://onlinecourses.nptel.ac.in/noc20_cs04/preview 3. Operating Systems Course for Beginners: https://www.youtube.com/watch?v=yK1uBHPdp30 4. Basic Unix Commands: https://www.unixtutorial.org/basic-unix-commands 5. Shell Scripting Tutorial: https://www.youtube.com/watch?v=GtovwKDemnI 	



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DATA STRUCTURES			
Semester	I	CIE Marks	50
Course Code	24MCPC514	SEE Marks	50
Teaching Hrs/Week(L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory+24 Lab)	Credits	03
Course Learning Objectives:			
This course is designed to			
<ol style="list-style-type: none"> 1. Familiarize the basic concepts of data structures. 2. Impart knowledge on the concepts of stack and its operations. 3. Develop an understanding of various types of queues and their implementations. 4. Construct an efficient program using appropriate data structures. 5. Develop a deep understanding of various tree and graph types. 			
Module 1 :Classification of Data Structures			No. of Hrs: 06+06
Introduction to data structure, Types of data structures, Data structure Operations, Arrays: Linear arrays, Representation of Linear array in memory, Traversing linear array, Inserting and Deleting, Sorting Techniques: Bubble Sort, Selection Sort, Merge sort, Quicksort, Insertion Sort, Searching: Sequential search, Binary search.			
Textbook 3 - Ch 3, 4			
Textbook 2 - Ch 4, 6			
Laboratory Component			
<ol style="list-style-type: none"> 1. Write a C program to implement the following search techniques: <ol style="list-style-type: none"> a) Linear Search b) Binary Search 2. Write a C program to implement the following sorting algorithms using user-defined functions: <ol style="list-style-type: none"> a) Bubble sort (Ascending order) b) Selection sort (Descending order) 			
Module 2 : Stack and its Applications			No. of Hrs: 05+06
Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, Recursion: Factorial, GCD, Fibonacci Sequence.			
Textbook 3 - Ch 6			
Laboratory Component			
<ol style="list-style-type: none"> 3. Write a C program to implement stack with the following operations: <ol style="list-style-type: none"> a) Push an element on to stack. b) Pop an element from the stack. 4. Implement a program in C for evaluating a given Postfix Expression. 5. Write a C program to find the factorial of a given number using recursion. 			



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Module 3 :Queue and its Applications

No. of Hrs: 05+04

Definition, Representation, Queue Variants: Simple Queue, Circular Queue, Priority Queue, Double-Ended Queue; Applications of Queues, Operations on Queue, Programming Examples.

Textbook 1 - Ch 3

Laboratory Component

6. Design, develop, and execute a program in C to simulate the working of a queue of integers using an array. Perform the following operations:
 - a) Insert
 - b) Delete
 - c) Display

Module 4 :Linked List

No. of Hrs: 05+04

Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation, Memory management functions. Definition, Representation, Operations: getnode() and freenode() operations, Types: Singly Linked List. Linked list as a Data Structure, Inserting and removing nodes from a list, Linked implementations of stacks and queues, Header nodes.

Textbook 3 - Ch 7

Laboratory Component

7. Write a C program to simulate the working of a singly linked list with the following operations:
 - a) Insert
 - b) Delete
 - c) Display

Module 5 :Trees and Graph

No. of Hrs: 05+04

Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals – In-order, Post-order, Pre-order

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Operations, Traversal methods: Breadth First Search and Depth First Search.

Textbook 3 - Ch 8, 9

Textbook 1 - Ch 5, 6

Laboratory Component

8. Develop C programs on binary trees. (Construct a binary search tree and traverse the tree using all the methods i.e., In-order, Post-order, Pre-order).



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Course Outcomes:

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

CO1: Make use of the appropriate sorting and searching techniques for a given scenario.

CO2: Implement the concepts of stack to solve a given problem.

CO3: Apply the queue concepts to solve a given problem.

CO4: Implement the operations of stacks and queues using linked list concepts.

CO5: Build different types of trees and graphs and perform traversals on them.

Textbooks:

1. Ellis Horowitz and Sartaj Sahni, “*Fundamentals of Data Structures in C*”, 2nd Edition, Universities Press, 2023
2. Seymour Lipschutz, “*Data Structures Schaum's Outlines*”, Revised 1st Edition, McGraw Hill, 2014
3. Bala Guruswamy, “*Programming in ANSI C*”, 8th Edition, McGraw Hill, 2024

Reference Books:

1. Gilberg & Forouzan, “*Data Structures: A Pseudocode approach with C*”, 2nd Edition, CengageLearning, 2014
2. Reema Thareja, “*Data Structures using C*”, 3rd Edition, Oxford Press, 2012

Web Links:

1. Introduction to Data Structure: <https://archive.nptel.ac.in/courses/106/102/106102064/>
2. Trees and Graphs: www.javatpoint.com/tree-vs-graph-data-structure3
3. Binary Tree: <https://www.mygreatlearning.com/blog/data-structures-using-c/#binary-tree>

COMPUTER NETWORKS

Semester	I	CIE Marks	50
Course Code	24MCP515	SEE Marks	50
Teaching Hrs/Week(L:T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Build an understanding of the fundamental concepts in computer networks.
2. Outline the different challenges in communication and to provide appropriate solutions.
3. Summarize the limitations of the different layers in the OSI reference model while transmitting data.
4. Demonstrate error detection and correction techniques.

Module 1 : Introduction	No. of Hrs: 10
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Uses of Computer Networks, Types of computer network, Network Technology from local to global, Reference Models: The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models, Networks protocols, Protocol Layering.

Physical Layer- Guided Transmission Media, Wireless Transmission. **Textbook 1- Ch 1, 2**

Module 2 : Data Link Layer	No. of Hrs: 08
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Data link Layer design issues, Error Detection and correction Techniques, Elementary data link protocol, Simple Protocol, Stop and Wait Protocol, Stop and Wait ARQ Protocol, Sliding Window Protocols (Go-Back-N (GBN) and Selective Repeat (SR)).

Textbook 1 - Ch 3

Module 3 : Network Layer	No. of Hrs: 08
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Network Layer Design issues, Routing algorithms- Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical routing, IPV4 Protocol, IP Addresses, IPV6 Protocol.

Textbook 1 - Ch 5

Module 4 : Transport Layer	No. of Hrs: 08
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Transport-Layer Services, Elements of transport protocol: Addressing, Connection establishment and Release, Error control and Flow control, Multiplexing, Crash Recovery, The Internet Transport Protocol: UDP, The Internet Transport Protocol: TCP

Textbook 1 - Ch 6

Module 5 : Application Layer	No. of Hrs: 08
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Introduction, Client Server Programming, WWW and HTTP, FTP, Electronic Mail, Telnet, Domain Name System(DNS), Multimedia Data, Multimedia in the internet.

Textbook 2 - Ch 25, 26, 28



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Course Outcomes:

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

CO1: Outline the fundamental principles of computer networking and enumerate its layers and protocols.

CO2: Identify the issues related to design, services, interfaces and protocols in the data link layer and network layer.

CO3: Apply various routing algorithms to solve a given problem in the network layer.

CO4: Solve the issues related with the transport and application layers by using various networking techniques.

Textbooks:

1. Andrew S. Tanenbaum, David J Wetherall, “*Computer Networks*”, 6th Edition, Pearson Education, 2023
2. Behrouz A Forouzan, “*Data Communication and Networking*”, 5th Edition, Tata McGraw-Hill, 2013

Reference Books:

1. Alberto Leon-Garcia, Indra Widjaja, “*Communication Networks - Fundamental Concepts and Key architectures*”, 2nd Edition, Tata McGraw-Hill, 2004
2. William Stallings, “*Data and Computer Communication*”, 8th Edition, Pearson Education, 2007

Web Links:

1. Introduction to Computer Network: <https://www.javatpoint.com/computer-network-tutorial>
2. Data Communication: <https://elearn.daffodilvarsity.edu.bd/course/view.php?id=5457>
3. Computer Networks and Internet Protocol: https://onlinecourses.nptel.ac.in/noc21_cs18/preview
4. Error Detection in Computer Networks: <https://www.geeksforgeeks.org/error-detection-in-computer-networks/>



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Invent Solutions

SOFTWARE ENGINEERING

Semester	I	CIE Marks	50
Course Code	24MCPC516	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Impart the fundamental principles, methodologies, and best practices involved in software engineering.
2. Learn to gather, analyze, and document both functional and non-functional requirements from stakeholders to ensure the software meets user needs.
3. Enable students to design scalable, maintainable, and efficient software systems using appropriate software design patterns and architectural styles (e.g., MVC, layered architecture, microservices).
4. Provide knowledge on the various testing techniques unit, integration, system, and acceptance testing to ensure software quality.
5. Impart skills on effective project management and quality management.

Module 1: Introduction	No. of Hrs: 08
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Professional software development: Software engineering ethics, **Software processes:** Software process models, Process activities, Coping with change, The rational unified process.

Textbook 1 - Ch 1, 2

Module 2: Requirements Engineering	No. of Hrs: 08
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Requirements engineering: Functional and non-functional requirements, The Software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Textbook 1 - Ch 4

Module 3: Software Architecture	No. of Hrs: 08
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Role of Software Architecture, Architectural Views, **Component and Connector View :**

Components, Connectors, Architectural Styles for C & C View : Pipe and Filter, Shared-Data Style, Client-Server Style, Other Styles, **Architectural Discussion :** Architecture and Design, Preserving the Integrity of an Architecture, Deployment View and Performance Analysis, Documenting Architecture Design, **Evaluating Architectures :** The ATAM Analysis Method.

Textbook 2 - Ch 4

Module 4 : Software Testing	No. of Hrs: 12
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Testing Fundamentals : Error, Fault, and Failure, Test Oracles, Test Cases and Test Criteria, Psychology of Testing, **Black-box Testing :** Equivalence Class Partitioning, Boundary Value Analysis, Cause-Effect Graphing, Pair-wise Testing, Special Cases, State-Based Testing, **White-Box Testing :** Control Flow-Based Criteria, Data Flow-Based Testing, Mutation Testing, Test Case Generation and Tool Support, **Testing Process :** Levels of Testing, Test Plan, Test Case Specifications, Test Case Execution and Analysis, Defect Logging and Tracking, **Defect Analysis and Prevention :** Pareto Analysis, Perform Causal Analysis, Develop and Implement Solutions.

Textbook 2 - Ch 10

Module 5: Project Management	No. of Hrs:06
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Project management: Risk management, Managing people, Teamwork.

Project planning: Software pricing, Plan-driven development, Project scheduling, Estimation



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techniques. Quality management: Software quality, Software standards, Reviews and inspections, Software measurement and metrics.

Textbook 1 - Ch 22, 23, 24

Course Outcomes:

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

CO1: Apply the right software process model for a given problem scenario.

CO2: Identify the functional and non-functional requirements while building a software application.

CO3: Choose an appropriate architectural style for a given problem.

CO4: Apply key testing concepts and generate effective test cases using different testing techniques.

CO5: Apply key principles of project management and quality management in software development.

Textbooks:

1. Ian Sommerville, “*Software Engineering*”, 9th Edition, Pearson Education, 2012
2. Pankaj Jalote, “*An Integrated Approach to Software Engineering*”, 3rd Edition, Springer New York, 2005

Reference Books:

1. Roger S. Pressman, Bruce R Maxim, “*Software Engineering - A Practitioner’s approach*”, 9th Edition, Tata McGraw Hill, 2023
2. Stephan R. Schach, “*Object Oriented Software Engineering*”, 1st Edition, Tata McGraw Hill, 2008
3. Michael Blaha, James Rumbaugh, “*Object Oriented Modelling and Designwith UML*”, 2nd Edition, Pearson Education, 2005

Web Links:

1. Software Engineering Resources :<https://github.com/Alliedium/awesome-softwareEngineering>
2. All Software Engineering Resources :<http://www.cmcrossroads.com/bradapp/links/swelinks.html>
3. Resources for Software Engineering :https://www.1000sourcecodes.com/2012/05/software-engineeringresources.html#google_vignette

WEB TECHNOLOGIES			
Semester	I	CIE Marks	50
Course Code	24MCPC517	SEE Marks	50
Teaching Hrs/Week (L:T:P)	(2:0:2)	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Provide knowledge on some basic tags of HTML.
2. Impart skills to execute simple web pages using HTML and CSS.
3. Familiarize the concepts to design layouts using advanced CSS techniques.
4. Impart knowledge to develop dynamic documents using JavaScript with CSS.
5. Disseminate knowledge to create dynamic web pages using PHP, MySQL and connection to a server.

Module 1 : Introduction to HTML	No. of Hrs: 06+04
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HTML Syntax, Semantic Markup, Structure of HTML Documents: DOCTYPE, Head and Body, HTML Elements: Headings, Paragraphs and Divisions, Links, URL Relative Referencing, Inline Text Elements, Images, Character Entities, Lists, HTML5 Semantic Structure Elements: Header and Footer, Heading Groups, Navigation, Articles and Sections. Introducing Tables, Forms, Form Control elements, Table and Form accessibility.

Textbook 1 – Ch 2, 4

Laboratory Components

1. Create a simple HTML webpage with headings, paragraphs, an image, and a link.
2. Design an HTML document that includes a table and a form with various input elements.
3. Create a structured HTML5 document using semantic elements like header, footer, nav, article, and section.

Module 2: Introduction to CSS	No. of Hrs: 05+04
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Define CSS. Benefits of CSS, CSS Syntax: Selectors, Properties, Values, Location of Styles: Inline Styles, Embedded Style Sheet, External Style Sheet. Selectors: Element Selectors, Class Selectors, Id Selectors, Attribute Selectors, Pseudo-Element and Pseudo-Class Selectors, Contextual Selectors. The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

Textbook 1 – Ch 3

Laboratory Components

4. Apply basic CSS styles using inline styles, embedded styles, and an external stylesheet.
5. Design a responsive webpage using media queries and a CSS framework.
6. Style an HTML form with CSS to make it visually appealing and accessible

Module 3: Advanced CSS: Layout	No. of Hrs: 05+04
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Normal Flow, Positioning Elements: Relative Positioning, Absolute Positioning. Floating Elements: Floating within a Container, Floating Multiple Items Side by Side, Containing Floats, Overlaying and Hiding Elements. Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

Textbook 1 – Ch 5



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Laboratory Components

7. Create an HTML document with elements positioned using relative and absolute positioning.
8. Design a multi-column layout using CSS floats, including a header, columns, and a footer.
9. Build a complex, responsive multi-column layout using CSS Grid.

Module 4 : JavaScript: Client-Side Scripting	No. of Hrs: 05+06
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JavaScript: Client-Side Scripting, JavaScript's History and Uses. JavaScript Design Principles, Inline JavaScript, Embedded JavaScript, External JavaScript, Advanced Inclusion of JavaScript. Syntax: Variables, Comparison Operators, Logical Operators, Conditionals, Loops, Functions, Errors Using Try and Catch. JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms: Validating Forms, Submitting Forms.

Textbook 1 – Ch 6

Laboratory Components

10. Write a JavaScript script to perform basic arithmetic operations and display the results.
11. Implement form validation using JavaScript to check input fields and display error messages.
12. Use JavaScript to manipulate the DOM by changing content and styles of elements on user interaction.

Module 5 : PHP with MySQL	No. of Hrs: 05+06
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PHP: PHP Tags, PHP Comments, Variables, Data Types, and Constants, Writing to Output. Program Control, Functions, Arrays, \$_GET and \$_POST Superglobal Arrays, \$_SERVER Array, \$_FILES Array.

Databases and Web Development, SQL, Database APIs, Managing a MySQL Database, Accessing MySQL in PHP.

Textbook 1 – Ch 8, 11

Laboratory Components

1. Write a basic PHP script to display a message and incorporate HTML within the PHP script.
2. Handle form submissions using PHP to process and display the submitted data.
3. Connect to a MySQL database with PHP and perform CRUD operations (Create, Read, Update, Delete).

Course Outcomes:

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

CO1: Utilize foundational HTML tags in web pages.

CO2: Build static web pages with a combination of HTML for structure and CSS for styling.

CO3: Identify complex and responsive layouts that adapt to different screen sizes.

CO4: Make use of Document Object Model (DOM) in JavaScript to add, remove, or modify the content of your web pages.

CO5: Build dynamic web pages that interact with databases using PHP, a server-side scripting language.

Textbooks:

1. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, Pearson.



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Reference Books:

1. *HTML5 Black Book*, 3rd Edition, Dreamtech Press, 2019.
2. M. Deitel, P.J. Deitel, A. B. Goldberg, *Internet & World Wide Web: How to Program*, 5th Edition, Pearson Education, 2008.

Web Links:

1. Introduction to Web Technologies and HTML 5: https://www.youtube.com/watch?v=r4F5tY_6u70
2. CSS full course for beginners: <https://www.youtube.com/watch?v=n4R2E7O-Ngo>
3. PHP & MySQL for beginners: <https://www.youtube.com/watch?v=cGwSm8xDSwI>



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Invent Solutions

PROFESSIONAL COMMUNICATION AND ETHICS

Semester	I	CIE Marks	-
Course Code	24MCNM518	SEE Marks	-
Teaching Hrs/Week (L:T:P)	1:1:0	Exam Hrs	-
Total Hrs	26	Credits	-

Course Learning Objectives:

This course is designed to

1. Impart knowledge on the fundamental concepts of interpersonal and professional communication.
2. Provide knowledge on active listening with focus on content, purpose, ideas and tone.
3. Facilitate fluent speaking skills in social, academic and professional situations.
4. Disseminate effective writing skills in business, technology and academic arenas.
5. Instil essential social and professional skills necessary to navigate various interpersonal interactions effectively

Module 1: Fundamentals of Communication	No. of Hrs: 05
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Introduction, An Overview of Communication, Process of Communication, Purpose of Professional Communication, Different Forms of Communication, Communication Network in an Organization, Barriers to Communication, Some Remedies.

Textbook 1 – Ch 1

Module 2: Listening Skills	No. of Hrs: 05
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Developing Effective Listening Skills: Listening Is an Art, Listening vs Hearing, Poor Listening vs Effective Listening, Advantages of Good Listening, Process of Listening, Types of Listening, Intensive Listening vs Extensive Listening, Barriers to Effective Listening, Five Steps to Active Listening, Techniques for Effective Listening.

Textbook 1 – Ch 3

Module 3: Speaking Skills	No. of Hrs: 05
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Non-verbal Communication: Body Language, Paralinguistic Features, Proxemics/Space Distance.

Group Discussions: Introduction, Difference Between GD and Debate, Personality Traits to be Evaluated, Dynamics of Group Behaviour/Group Etiquette and Mannerisms.

Job Interviews: Introduction, Process, Stages in Job Interviews, Types, Desirable Qualities, Preparation, Using Proper Verbal and Non-verbal Cues, Exhibiting Confidence.

Textbook 1 – Ch 4

Module 4: Writing Skills	No. of Hrs: 05
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Business Letters, Elements of Style, Types of Business Letters: Acknowledgement Letter, Letter of Recommendation, Appreciation Letter, Acceptance Letter, Apology Letter, Complaint Letter, Adjustment Letter, Inquiry Letter, Permission Letter, Invitation Letter, Rejection Letter, Order Letter, Application Letters and Cover Letters, Sales Letters.

Resume Preparation, Business Reports: Structure of Formal Reports, Email and Blog Writing.

Textbook 1 – Ch 6

Module 5: Effective Presentations and Etiquettes	No. of Hrs:06
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Presentation: Essential Characteristics of a Good Presentation, preparing a presentation, delivering the presentation,

Business Etiquettes: Introductions, Formal Dress Code, Formal Dining Etiquettes, Conflict



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management through communication.

Textbook 2 – Ch 14,15,16

Course Outcomes:

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

- CO1:** Show how to eliminate barriers and use verbal/non-verbal cues at social and workplace situations.
- CO2:** Outline listening strategies to comprehend wide-ranging vocabulary, grammatical structures, tone and pronunciation.
- CO3:** Interpret effective speaking skills at social, academic and business situations.
- CO4:** Interpret effective writing skills for drafting academic, business and technical documents.
- CO5:** Outline the necessary skills and knowledge to navigate social and professional interactions with confidence and grace.

Textbooks:

1. Sanjay Kumar & Pushp Lata, “*Communication Skills with CD*”, New Delhi: Oxford University Press, 2018
2. P. D. Chaturvedi, Mukesh Chaturvedi, “*Business Communication*”, Pearson, 2012

Reference Books:

1. Hemphill, P.D., McCormick, D. W., & Hemphill, R. D. “*Business Communication with writing improvement exercises*”, Upper Saddle River, NJ: Prentice Hall, 2001
2. Raman, M., & Sharma S, “*Technical Communication: Principles and practice*”, New Delhi, Oxford University Press, 2016
3. Kaul, A. *Effective Business Communication*, Prentice Hall India Learning Pvt Ltd, 2015.
4. Rizvi, A. M. *Effective Technical Communication: A guide for Scientists and Engineers*, New Delhi, Tata McGraw Hill, 2010

Web Links:

1. Professional Communication Skills: <https://www.onestopenglish.com/adults/business-and-esp/esp-lesson-plans/professional-communication-skills>
2. Effective Communication: <https://communicationprogram.wharton.upenn.edu/library/>
3. Professional Communication: <https://www.futurelearn.com/courses/effective-communication-skills-for-professionals>
4. Business Etiquette: <https://www.youtube.com/watch?v=15XC6R80wb4>



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II SEM



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DESIGN AND ANALYSIS OF ALGORITHMS			
Semester	II	CIE Marks	50
Course Code	24MCPC521	SEE Marks	50
Teaching Hrs /Week (L: T:P)	4:0:0	Exam Hrs	03
Total Hrs	52	Credits	04
Course Learning Objectives:			
This course is designed to			
<ol style="list-style-type: none"> 1. Provide a solid foundation in the basic concepts of algorithms, including their types, structure, and efficiency in solving computational problems. 2. Instil the ability to analyse the asymptotic performance of algorithms and evaluate their efficiency. 3. Familiarize students with various algorithm design paradigms, such as Divide and Conquer, Greedy Method, and Dynamic Programming, through illustrative problem-solving. 4. Instil the knowledge required to design, optimize, and implement efficient algorithms tailored to real-world engineering scenarios, incorporating advanced techniques like Backtracking, Branch and Bound, and Randomized Algorithms. 			
Module 1: Introduction	No. of Hrs: 12		
Notion of an Algorithm, Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity and notation, Mathematical analysis of Non-Recursive and recursive Algorithms, Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Little-oh) with Examples, Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems.			
Textbook 1 - Ch 1, 2			
Textbook 2 - Ch 1			
Module 2: Divide and Conquer	No. of Hrs: 10		
General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum, Merge sort, Quick sort, Strassen's matrix multiplication, Advantages and Disadvantages of divide and conquer. Decrease and Conquer Approach: Topological Sort. Transform and Conquer Approach: Heaps and Heap Sort.			
Textbook 1 - Ch 4, 5, 6			
Textbook 2 - Ch 3			
Module 3: Algorithms	No. of Hrs: 10		
Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm. Single source shortest paths: Dijkstra's Algorithm. Optimal Tree problem: Huffman Trees and Codes.			



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Textbook 1 - Ch 9

Textbook 2 - Ch 4

Module 4: Dynamic Programming

No. of Hrs: 10

General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Salesman problem.

Textbook 1 - Ch 8

Textbook 2 - Ch 5

Module 5: Backtracking

No. of Hrs: 10

General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. Programme and Bound: Assignment Problem, Travelling Salesperson problem, 0/1 Knapsack problem: LC Programme and Bound solution, Probabilistic and Randomized Algorithms: Probabilistic Algorithms, Randomizing deterministic Algorithms, MonteCarlo Algorithm, Biased Monte Carlo Algorithms: A Monte Carlo algorithm for testing polynomial quality, Non deterministic algorithms: P, NP complete, NP-Hard problems.

Textbook 1 - Ch 12

Textbook 2 - Ch 8, 11

Course Outcomes:

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

CO1: Apply the fundamental concepts of algorithms, including asymptotic analysis and performance evaluation, to analyse space and time complexities for various algorithms.

CO2: Demonstrate the ability to solve problems using Divide and Conquer, Decrease and Conquer, and Transform and Conquer approaches, and analyse their efficiency in real-world scenarios.

CO3: Apply Greedy algorithms to solve optimization problems such as Knapsack, Job Sequencing, and Minimum Spanning Tree, and evaluate their performance.

CO4: Apply dynamic programming techniques to solve optimization problems using algorithms like Warshall's, Floyd's, Bellman-Ford, Knapsack, and TSP.

CO5: Implement Backtracking and Branch & Bound methods to solve combinatorial and optimization problems such as N-Queens, Graph Colouring, and Travelling Salesperson, and classify algorithms into complexity classes like P, NP, and NP-Hard.

Textbooks:

1. Anany Levitin, “*Introduction to the Design and Analysis of Algorithms*”, 3rd Edition, Pearson Education, 2012
2. Ellis Horowitz, Sartaj Sahni and Rajasekaran, “*Computer Algorithms/C++*”, 2nd Edition, Universities Press, 2014

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “*Introduction to Algorithms*”, 3rd Edition, MIT Press, 2009



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2. S. Sridhar, “*Design and Analysis of Algorithms*”, 2nd Edition, Oxford Higher Education, 2023

Web Links:

1. Design and Analysis of Algorithms: <https://www.codechef.com/learn/course/college-design-analysis-algorithms>
2. Algorithms: Design and Analysis: <https://online.stanford.edu/courses/soe-ycsalgorithms1-algorithms-design-and-analysis-part-1>
3. Design and Analysis of Algorithms: <https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/>



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Invent Solutions

PROGRAMMING WITH JAVA

Semester	II	CIE Marks	50
Course Code	24MCPC522	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:2	Exam Hrs	03
Total Hrs	64 (40 Theory + 24 Lab)	Credits	04

Course Learning Objectives:

This course is designed to

1. Impart the fundamental concepts of Object-Oriented Programming.
2. Classify the different programming constructs used in Java Programming.
3. Use the concepts of multiple inheritance and interface in solving real-time problems.
4. Enable students to use exception handling techniques while solving programming problems.
5. Build applications using the concepts of multithreading.

Module 1: OOPS Concepts and Java Programming	No. of Hrs: 08+04
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OOP Concepts: Classes and objects, data abstraction, encapsulation, inheritance, polymorphism, procedural and object oriented programming paradigm. **Java programming:** History of java, comments, data types, variables, constants, scope and lifetime of variables, operators, operator hierarchy, expressions, type conversion and casting, control flow statements, jump statements, simple java stand-alone programs, arrays, console input and output, formatting output, constructors methods, static fields and methods, access control, overloading methods and constructors, recursion.

Textbook 1 - Ch 1, 2, 3

Laboratory Component

1. Write a Java program to print the following triangle of numbers.

```

1
1 2
1 2 3
1 2 3 4
1 2 3 4 5

```

2. Write a Java program to list the factorial of the numbers 1 to 10. To calculate the factorial value, use a while loop. (Hint Fact of 4 = 4*3*2*1)

Module 2: Introduction to Java	No. of Hrs: 08+04
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Basics of Java: Features of Java, Byte Code and Java Virtual Machine, JDK, Data types, Operator, Control Statements – If, else, nested if, if-else ladders, Switch, while, do-while, for, for-each, break, continue.

Array and String: Single and Multidimensional Array, String class, StringBuffer class, Operations on string, Command line argument, Use of Wrapper Class.

Textbook 1 - Ch 4, 5, 7



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Invent Solutions

Laboratory Component

3. Write a Java program that calculates and displays grades based on student scores stored in an array.
4. Write a Java program that analyzes a given text string and provides statistics on characters, words, and sentences.

Module 3: Multiple inheritance and interface

No. of Hrs:08+06

Inheritance: Inheritance hierarchies, super and subclasses, member access rules, super keyword, preventing inheritance: final classes and methods, the object class and its methods; **Polymorphism** dynamic binding, method overriding, abstract classes and methods, defining an interface, implement interfaces, accessing implementations through interface references, extending interface.

Textbook 1 - Ch 8

Laboratory Components

5. Write a Java program:
 - a. To find the area and circumference of the circle by accepting the radius from the user.
 - b. To accept a number and find whether the number is Prime or not.
6. Write a Java program to demonstrate Multiple inheritance using interfaces and to calculate the area of a rectangle and triangle.

Module 4:Exception Handling

No. of Hrs:08+04

Exception Handling: Benefits of exception handling, the classification of exceptions, exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, rethrowing exceptions, exception specification, built in exceptions, creating own exception subclasses.

Textbook 1 – Ch 10

Laboratory Components

7. Write a Java program to demonstrate Constructor Overloading and Method Overloading.
8. Write a Java program to handle divide by zero Exception.

Module 5 : Multi-Threaded programming

No. of Hrs:08+06

Multithreading fundamentals: The Thread Class and Runnable Interface, Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities, Synchronization, using Synchronization Methods, The Synchronized Statement, Thread Communication using notify(), wait() and notify All(), suspending, Resuming and stopping Threads.

Textbook 1 – Ch 12

Laboratory Components

9. Write a Java program to create multiple threads using different thread methods.
10. Write a Java program to perform the following operations.
 - a) Thread 1: Display the natural numbers from 1 to 100.
 - b) Thread 2: Display even numbers from 2 to 100
 - c) Thread 3: Display odd numbers from 1 to 99.
 - d) Set Thread Properties so that thread 2 must run at beginning followed by thread 3 and at last thread 1 must be executed.



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Course Outcomes:

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

CO1: Illustrate the basic concepts of Object-Oriented Programming in Java.

CO2: Use the inheritance concepts on a variety of real-time applications.

CO3: Apply Exception handling concepts to write effective programs in Java.

CO4: Develop applications using Multithreaded Programming.

Textbooks:

1. Herbert Schildt and Dale Skrien, “*Java Fundamentals – A Comprehensive Introduction*”, 1st Edition, McGraw Hill, 2013
2. Herbert Schildt, “*Java the Complete Reference*”, 7th Edition, McGraw Hill, 2011
3. T. Budd, “*Understanding Object-Oriented Programming with Java*”, Pearson Education, 1999

Reference Books:

1. P. J. Dietel and H. M. Dietel, “*Java How to program*”, 6th Edition, Prentice Hall, 2005
2. P. Radha Krishna, *Object Oriented programming through Java*”, 1st Edition, CRC Press, 2007
3. S. Malhotra and S. Choudhary, “*Programming in Java*”, 2nd Edition, Oxford University Press, 2014

Web Links:

1. Learn Java :<https://www.codecademy.com/learn/learn-java>
2. Introduction to Java programming: <https://www.mygreatlearning.com/academy/learn-for-free/courses/java-programming>
3. Programming in Java: https://onlinecourses.nptel.ac.in/noc20_cs58/preview
4. Object-Oriented programming: <https://www.coursera.org/specializations/object-oriented-programming>



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Invent Solutions

DATABASE MANAGEMENT SYSTEMS

Semester	II	CIE Marks	50
Course Code	24MCPC523	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Provide a strong foundation in database concepts, technology, and practice.
2. Develop SQL programming skills through a variety of database problems.
3. Impart knowledge on the use of concurrency and transactions in a database system.
4. Deliver database applications for real-world problems.

Module 1: Introduction to Databases	No. of Hrs: 06+06
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Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. **Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles and structural constraints, Weak entity types, ER diagrams.

Textbook 1 – Ch 1, 2, 3

Laboratory Components:

1. Consider the following schema: STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA).

Execute the following queries:

- a. Update the column total by adding the columns mark1, mark2, mark3.
- b. Find the GPA score of all the students.
- c. Find the students who were born on a particular year of birth from the date_of_birth column.
- d. List the students who are studying in a particular branch of study.
- e. Find the maximum GPA score of the student branch-wise.
- f. Find the students whose name starts with the alphabet “S”.
- g. Find the students whose name ends with the alphabet “AR”.
- h. Delete the student details whose USN is given as 1001.

2. Consider the following database of student enrollment in courses and books adopted for each course.

STUDENT (regno#: string, name: string, major: string, bdate: date) COURSE

(course#: int, cname: string, dept: String)

TEXT(book_ISBN#: int, book_title: string, publisher: string, author: string)

ENROLL (regno#: string, course#: int, sem: int, marks: int) BOOK_ADOPTION

(course#: int, sem: int, book_ISBN: int)

Execute SQL queries for the following:

- a. List out the student details, and their course details. The records should be ordered in a

semester-wise manner.

- b. List out the student details under a particular department whose name is ordered semester-wise.
- c. List out all the book details under a particular course.
- d. Find out the Courses in which the number of students studying are more than 2.
- e. Find out the Publisher who has published more than 2 books.

Module 2: Relational Model	No. of Hrs: 05+06
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Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. **Relational**

Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. **Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.

Textbook 1 – Ch 5, 8, 9

Laboratory Components:

3. Design an ER-diagram for the following scenario, Convert the same into a relational model and then solve the following queries. Consider a Cricket Tournament “ABC CUP” organized by an organization. In the tournament, many teams are contesting each having a Teamid, Team_Name, City and a coach. Each team is uniquely identified by using Teamid. A team can have many Players and a captain. Each player is uniquely identified by Playerid, having a Name, and multiple phone numbers, age. A player represents only one team. There are many Stadiums to conduct matches. Each stadium is identified using Stadiumid, having a stadium_name, Address (involves city,area_name,pincode). A team can play many matches. Each match is played between the two teams on the scheduled date and time in the predefined Stadium. Each match is identified uniquely by using Matchid. Each match won by any of the one team that also wants to record in the database. For each match man_of_the match award given to a player.

Execute the following queries:

- a. Display the youngest player (in terms of age) Name, Team name, age in which he belongs to the tournament.
- b. List the details of the stadium where the maximum number of matches were played.
- c. List the details of the player who is not a captain but got the man_of_match award at least in two matches.
- d. Display the Team details who won the maximum matches.
- e. Display the team's name where all its won matches played in the same stadium.

Module 3: Structured Query Language	No. of Hrs:05+06
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SQL:SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. **Advanced**

Queries:More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.

Textbook 1 – Ch 6, 7

Laboratory Components:

4. A country wants to conduct an election for parliament. A country has many constituencies. Each constituency is identified uniquely by Constituency_id, having the Name, belongs to a state, Number_of_voters. A constituency can have many voters. Each voter is uniquely identified by using Voter_id, having the Name, age, address (involves Houseno, city, state, pincode). Each voter belongs to only one constituency. Many candidates are contesting in the election. Each candidate is uniquely identified by using candidate_id, having Name, phone_no, age, state. A candidate belongs to only one party. There are many parties. Each party is uniquely identified by using Party_id, having Party_Name, Party_symbol. A candidate can contest from many constituencies under the same party. A party can have many candidates contesting from different constituencies. No constituency having the candidates from the same party. A constituency can have many contesting candidates belonging to different parties. Each voter votes for only one candidate of his/her constituency.

Execute the following queries:

- a. List the details of the candidates who are contesting from more than one constituency which belongs to different states.
- b. Display the state name having the maximum number of constituencies.
- c. Create a stored procedure to insert the tuple into the voter table by checking the voter age. If the voter's age is at least 18 years old, then insert the tuple into the voter else display the “Not an eligible voter msg”.
- d. Create a stored procedure to display the number_of_voters in the specified constituency. Where the constituency name is passed as an argument to the stored procedure.
- e. Create a TRIGGER to UPDATE the count of “Number_of_voters” of the respective constituency in the “CONSTITUENCY” table, after inserting a tuple into the “VOTERS” table.

Module 4: Normalization

No. of Hrs: 05+06



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Normalization: Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Examples of Normal Forms.

Textbook 1 – Ch 14

Laboratory Components:

5. Design an ER-diagram for the following scenario, Convert the same into a relational model, normalize Relations into a suitable Normal form and then solve the following queries. A country can have many Tourist places. Each Tourist place is identified by using tourist_place_id, having a name, belonging to a state, capital city of that state, history. There are many Tourists visiting tourist places every year. Each tourist is identified uniquely by using Tourist_id, having a Name, age, Country and multiple email ids. A tourist visits many Tourist places, it is also required to

record the visited_date in the database. A tourist can visit a Tourist place many times at different dates. A Tourist place can be visited by many tourists either on the same date or at different dates. Queries:

- a. List the state name which has the maximum number of tourist places.
- b. List details of Tourist places where the maximum number of tourists visited.
- c. List the details of tourists visiting all tourist places from the state “KARNATAKA”.
- d. Display the details of the tourists who visited at least one tourist place of the state but visited all tourist places in all states.
- e. Display the details of the tourist places visited by the tourists of all countries.

Module 5: Transaction Processing and Concurrency Control	No. of Hrs:05
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Transaction Processing: Introduction to Transaction Processing, Desirable properties of Transactions, Characterizing schedules based on Recoverability and Serializability, Transaction support in SQL. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multi version Concurrency control techniques, Validation Concurrency control techniques.

Textbook 1 – Ch 20, 21

Course Outcomes:

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

CO1: Describe database objects and integrity constraints on a database using RDBMS.

CO2: Utilize the concepts of relational model and relational algebra to solve a given problem definition.

CO3: Develop SQL queries for database manipulation.

CO4: Apply the concepts of normalization and design effective databases.

CO5: Use simple database systems to relate the concept of transaction, concurrency control and recovery.



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Text Books:

1. Ramez Elmasri, Shamkant B. Navathe, “*Fundamentals of Database System*”, 7th Edition, Pearson, 2017

Reference Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “*Database System Concepts*”, 6th Edition, Tata McGraw Hill Education Private Limited, 2011
2. Ramakrishnan and Gehrke, “*Database Management Systems*”, 3rd Edition, McGraw Hill, 2014

Web Links:

1. Database Management System: https://onlinecourses.nptel.ac.in/noc22_cs91/preview
2. Introduction to Databases: <https://archive.nptel.ac.in/courses/106/106/106106220/>
3. Database Management Essentials: <https://www.coursera.org/learn/database-management>



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Invent Solutions

OBJECT ORIENTED MODELING AND DESIGN

Semester	II	CIE Marks	50
Course Code	24MCPC524	SEE Marks	50
Teaching Hrs/Week (L: T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to:

1. Impart core Object-Oriented Principles while architecting and designing software applications.
2. Provide students with a comprehensive understanding of how OOMD fits into the broader context of the software development lifecycle.
3. Equip students with the tools and techniques to model and design software using object-oriented methodologies.
4. Critically assess object-oriented models for correctness, completeness, and maintainability.
5. Perform design reviews and walk-throughs to identify potential improvements in the system architecture.
6. Recognize the benefits and challenges of object-oriented modeling in large-scale system development.

Module 1: Introduction to Object-Oriented Modeling	No. of Hrs:06+06
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Object Orientation in Object-Oriented development, Usefulness of Object-Oriented Development, Object-Oriented modeling history, Modeling Concepts : Modeling as a design technique, Class modeling : Link and Association concepts, Generalization and Inheritance, A sample class model, Navigation of class models, Advanced Class Modeling : Association Ends, N-ary Associations, Aggregation, History and evolution of UML, UML Diagrams: Overview of Use Case, Class, Object, Sequence, Collaboration, Activity, Component, Deployment Diagrams, Tools for UML modeling.

Textbook 1 - Ch 1, 2, 3, 4, 7, 15

Textbook 2 - Ch 5, 7, 9, 10

Lab Component :

1. Model a library management system by identifying and defining classes, their attributes and methods. Create associations, generalizations and dependencies between classes.
2. Develop a use-case diagram for an online shopping application. Identify the actors, use cases and establishing relationships among the use cases.

Module 2: Object-Oriented Modeling – State Modeling and Advanced State Modeling	No. of Hrs: 05+06
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State Modeling : Events, States, Transition and conditions, State diagrams, State diagram behavior, Advanced State Modeling : Nested state diagrams, Nested states, Signal Generalization, Concurrency, A sample state model, Relation of class and state models.

Textbook 1 - Ch 5, 6

Lab Component :

3. Create a state diagram for an “order” in an ecommerce system. Define the different states (“Pending”, “Processed” and “Shipped” and the events that cause these transitions.
4. Use the ArgoUML tool to represent the different states while booking an airline ticket. Show the events that trigger the transitions.



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Module 3: Object Oriented Modeling – Interaction Modeling and Advanced Interaction Modeling	No. of Hrs: 05+06
<p>Interaction Modeling : Use Case models, Sequence models, Activity models, Advanced Interaction Modeling : Use Case relationships, Procedural sequence models, Special constructs for activity models, Concepts summary : Class model, State model, Interaction model, Relationship among the models.</p> <p>Textbook 1 - Ch 7, 8</p>	
<p>Lab Component :</p> <ol style="list-style-type: none">5. Model a sequence diagram for placing an order in an e-commerce platform. Identify the objects involved and the sequence of messages exchanged between them to complete the process.6. Create an activity diagram to model a payment processing workflow in an online shopping application. Define the activities, decision points and parallel activities to visualize the flow.	
Module 4: Object Oriented Design Principles	No. of Hrs: 05+06
<p>SOLID Principles : Single Responsibility, Open-Closed, Liskov Substitution, Interface Segregation, Dependency Inversion, Design by Contract : Preconditions, Postconditions, Invariants, Implementation of Object-Oriented Designs : Translating UML diagrams into code, Refactoring, Unit Testing and Test-Driven Development.</p> <p>Textbook 4 - Ch 4, 5, 8, 9, 10, 11, 12</p>	
Module 5: Object-Oriented Design Patterns	No. of Hrs: 05
<p>Design Patterns : What is a design pattern, Describing design patterns, The catalog of design patterns, Organizing the catalog, How design patterns solve design problems, Selecting design patterns, Using design patterns, Creational patterns : prototype and singleton, Structural patterns : adaptor and proxy.</p> <p>Textbook 2 - Ch 1, 3, 4</p>	
Course Outcomes:	
<p>At the end of the course, the student will be able to:</p> <p>CO1: Identify the system requirements for a given problem, key objects and relationships and model applications effectively in an Object-Oriented framework.</p> <p>CO2: Model the state of an object or a system for different use-case scenarios through state diagrams, and collaboration diagrams illustrating transitions and actions.</p> <p>CO3: Model object interactions and the flow of control during specific use cases or system scenarios.</p> <p>CO4: Develop the ability to incorporate SOLID principles in Object-Oriented design to create modular, scalable and maintainable systems.</p> <p>CO5: Apply relevant design patterns to solve common design problems and improve the overall software structure.</p>	
<p>Software Tools: UML Modeling Tools (StarUML/ArgoUML/BOUML)</p>	



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Textbooks:

1. Michael Blaha and James Rumbaugh, “*Object-Oriented Modeling and Design with UML*”, 2nd Edition, Pearson Education India, 2005
2. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides: “*Design Patterns –Elements of Reusable Object-Oriented Software*”, Pearson Education, 2007
3. Martin Fowler, “*UML Distilled: A Brief Guide to the Standard Object Modeling Language*”, 3rd Edition, Addison-Wesley, 2003
4. Martin C. Robert, Martin Micah, “*Agile Principles, Patterns and Practices in C#*”, Prentice Hall, 2006

Reference Books:

1. Grady Booch, “*Object-Oriented Analysis and Design with Applications*”, 3rd Edition, Addison-Wesley, 2007
2. Martin Fowler, “*UML Distilled: A Brief Guide to the Standard Object Modeling Language*”, 3rd Edition, Addison-Wesley Professional, 2004
3. Craig Larman, “*Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design*”, 2nd Edition, Prentice Hall Professional, 2002
4. Brett McLaughlin, Gary Pollice, and David West, “*Head First Object-Oriented Analysis and Design*”, 1st Edition, O'Reilly Media, Inc., 2006
5. Grady Booch, James Rumbaugh, and Ivar Jacobson, “*The Unified Modeling Language User Guide*”, 2nd Edition, Addison-Wesley, 2005

WebLinks:

1. UML Diagrams - Introduction to Object-Oriented Modeling on Visual Paradigm: <https://online.visual-paradigm.com/diagrams/features/uml-tool/>
2. SOLID Principles in Object-Oriented Design: <https://stackify.com/solid-design-principles/>
3. Articles on Object Oriented Modeling and Design: <https://www.getallarticles.com/category/object-oriented-modeling-and-design/>



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Invent Solutions

RESEARCH METHODOLOGY & IPR

Semester	II	CIE Marks	50
Course Code	24MCHM525	SEE Marks	50
Teaching Hrs/Week (L:T:P)	1:0:2*	Exam Hrs	2.5
Total Hrs	37 (13 Theory + 24 Self Learning)	Credits	02

Course Learning Objectives:

This course is designed to

1. Provide knowledge on how to define and approach a research problem.
2. Make students familiar with how to formulate a literature survey.
3. Instill skills to develop theoretical and conceptual frameworks and write an effective review.
4. Impart knowledge to perform data collection and know the importance in arriving at solutions.
5. Familiarize with the interface of IPR in today's real time scenario.

Module 1: Introduction to Research Methodology	No. of Hrs: 03+04
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Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process.

Textbook 1 – Ch 1

Laboratory Components

1. Identify a research area and define the research objectives.
2. Identify the types of research to be performed.
3. Identify the methods and methodology as a research approach.

Module 2: Defining the Research Problem	No. of Hrs: 03+06
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Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature: Place of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Textbook 1 – Ch 2

Textbook 2 – Ch 3

Laboratory Components

4. Identify research problem in the chosen area.
5. Apply literature survey to develop a theoretical framework.
6. Develop a literature review.

Module 3: Research Design	No. of Hrs: 02+04
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Research Design: Meaning of Research Design, Need for Research Design, Basic Principles of Experimental Designs.

Sample Design: Characteristics of a Good Sample Design, Different Types of Sample Designs, Selecting a Random Sample.



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Textbook 1 – Ch 3, 4

Laboratory Components

7. Develop a research design for the identified research problem.
8. Identify different sample designs.

Module 4: Data Collection

No. of Hrs: 03+06

Data Collection: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Collection of Secondary Data. Selection of Appropriate Method for Data Collection.

Report Writing: Different Steps in Writing Report, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Textbook 1 – Ch 6, 14

Laboratory Components

9. Develop a research model through data collection.
10. Develop a research paper.

Module 5: Intellectual Property (IP) Acts

No. of Hrs: 02+04

Intellectual Property (IP) Acts: Introduction to IP: Introduction to Intellectual Property (IP), different types of IPs and its importance in the present scenario. Infringement Act on Patent, Cyber Law, Copyright, Trade Mark.

Textbook 3 – Ch 3, 4

Laboratory Components

11. Perform a patent search.
12. Identify different types of IPs with examples.

Course Outcomes:

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

CO1: Apply various research methods and articulate the phases of the research process on different problems and arrive at an acceptable solution.

CO2: Choose appropriate functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks.

CO3: Identify the procedure to collect and categorize data as primary and secondary, interpret its meaning and write effective reports.

CO4: Analyze infringements on intellectual property and categorize them as CopyRight Act/Patent Act/Cyber Law/Trademark.



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Textbooks:

1. C.R. Kothari, *Research Methodology, Methods and Techniques*, 4th edition, Gaurav Garg New Age International, 2018
2. Ranjit Kumar, *Research Methodology a step-by- step guide for beginners*, 3rd Edition, SAGE Publications, 2011.
3. Dr. Santosh M Nejakar, Dr. Harish Bendigeri Research Methodology and Intellectual Property Rights, 4th Edition, 2023.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press.
2. N.K.Acharya Intellectual Property Rights, 6th Edition Asia Law House, 2013.

Web Links:

1. Introduction to Research Methodology: <https://www.enago.com/academy/choose-best-research-methodology/>
2. Research Methodologies: <https://library.tiffin.edu/researchmethodologies/whatareresearchmethodologies>
3. IPR and Patents: <https://www.edition.com/insights/patents-101-what-are-patents-and-how-do-you-acquire-them?refer=scroll-to-2-article&refer-type=article>.

CRYPTOGRAPHY AND CYBERSECURITY

Semester	II	CIE Marks	50
Course Code	24MCPE551	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:0	Exam Hrs	03
Total Hours	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Impart Knowledge on basic concepts of Computer security and Cryptography
2. Provide skills to utilize Symmetric and Asymmetric cryptographic algorithms, Message Authentication algorithms and Hash functions.
3. Familiarize various types of cyber-attacks and cyber-crimes and an overview of the cyber laws.
4. Instill the ability to analyse cyber security challenges, assess their implications and identify the nature of cybercrime in real-world scenarios.

Module 1 : Attacks on Computers, Computer Security and Cryptography	No. of Hrs: 08
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Attacks on Computers, Computer Security: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security mechanisms, A model for Network Security

Cryptography: Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography.

Textbook 1 - Ch 1, 3

Module 2: Symmetric Ciphers	No. of Hrs: 08
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Symmetric key Ciphers: Block Cipher principles & Algorithms (DES, AES), Block cipher modes of operation, Stream ciphers, RC4, Key distribution.

Asymmetric key Ciphers: Principles of public key cryptosystems, Algorithms (RSA, Diffie Hellman), Key Distribution.

Message Authentication Algorithms and Hash Functions: Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm.

Textbook 1 - Ch 4, 6, 9, 10,12

Module 3: Cyber Security	No. of Hrs: 08
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Classifications of Cyber Crimes, Tools and Methods: Password Cracking, Keyloggers, Spywares, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Textbook 2 - Ch 1, 4



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Module 4 : Cyber Security and privacy	No. of Hrs: 08
Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.	
Textbook 2 - Ch 9	
Module 5 : Cybercrime and Cyber terrorism	No. of Hrs: 08
Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes, the psychology, mindset, and skills of hackers and other cyber criminals. Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. Mini-Cases: The Indian Case of Online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.	
Textbook 2 - Ch 10, 11	
Course Outcomes: At the end of the course, the student will be able to: CO1: Apply fundamental principles of computer security and cryptography to identify and analyse different types of security attacks and mechanisms. CO2: Utilize symmetric and asymmetric cryptographic techniques, including DES, AES, RSA, and Diffie-Hellman, to design secure communication systems. CO3: Demonstrate the ability to apply tools and methods, such as password cracking, keyloggers, and SQL injection, to assess and mitigate cyber threats. CO4: Analyze the organizational implications of cyber security, including the impact of web threats, privacy issues, and social media security risks, to propose appropriate mitigation strategies. CO5: Investigate real-world cases of cybercrime and cyber terrorism, evaluating their psychological, ethical, and societal dimensions to derive actionable insights	
Textbooks: 1. William Stallings, “ <i>Cryptography and Network Security</i> ”, 8 th Edition, Pearson Education, 2020 2. Nina Godbole and Sunit Belpure, “ <i>Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives</i> ”, Wiley, 2011	
Reference Books: 1. C K Shyamala, N Harini, Dr T R Padmanabhan, “ <i>Cryptography and Network Security</i> ”, Wiley India, 2011 2. Forouzan Mukhopadhyay, “ <i>Cryptography and Network Security</i> ”, 3 rd Edition, McGraw Hill, 2015 3. B. B. Gupta, D. P. Agrawal, Haixiang Wang, “ <i>Computer and Cyber Security: Principles, Algorithm, Applications and Perspectives</i> ”, CRC Press Inc, 2019	



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Web Links:

1. Using Cryptography Correctly: <https://online.stanford.edu/courses/xacs130-using-cryptography-correctly>.
2. Introduction to Cryptography: <https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-cryptography>
3. Introduction to Cybersecurity(netcad):
<https://www.netacad.com/courses/introduction-to-cybersecurity?courseLang=en-US>

NETWORK SECURITY

Semester	II	CIE Marks	50
Course Code	24MCPE552	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Gain a solid foundation in network security principles.
2. Understand cryptographic techniques to secure communication.
3. Analyze various network threats, vulnerabilities, and mitigation strategies.
4. Configure and manage essential network security tools and protocols.

Module 1: Network Security Fundamentals	No. of Hrs: 08
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Introduction to Network Security Concepts: Need for Security, Security Attacks (Passive, Active), Security Services (Confidentiality, Integrity, Availability), Security Mechanisms (Encryption, Authentication, Access Control), Security Models (CIA Triad, Bell-LaPadula Model)

Symmetric Key Cryptography: Classical Encryption Techniques (Caesar Cipher, Vigenere Cipher), Modern Block Ciphers (DES, AES), Operating Modes (CBC, ECB, CTR).

Textbook 1: Ch 1, 3, 6

Module 2: Cryptographic Techniques	No. of Hrs: 08
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Advanced Encryption Standard: Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation.

Principles of Public-Key Cryptosystems, Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, Public-Key Cryptanalysis, The RSA Algorithm, The Security of RSA

Textbook 1: Ch 7, 9

Module 3: Network Security Applications	No. of Hrs: 08
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Network Access Control and Cloud Security, Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Addressing Cloud Computing Security Concerns, Transport-Level Security, Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH)

Textbook 1: Ch 16, 17

Module 4: Wireless Network Security	No. of Hrs: 09
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Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security. User Authentication, Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption, Federated Identity Management, Personal Identity Verification.

Textbook 1: Ch 15, 18

Module 5: Email & IP Security Management	No. of Hrs: 09
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Electronic Mail Security, Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy, DNSSEC, DNS-Based Authentication of Named Entities, Domain-Based Message Authentication, Reporting, and Conformance IP Security, IP Security,



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IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites.

Textbook 1: Ch 19, 20

Course Outcomes:

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

CO1: Apply security principles to identify and categorize real-world network threats.

CO2: Apply cryptographic algorithms and key management techniques to secure communication channels.

CO3: Apply secure communication protocols (TLS/SSL, VPNs) to configure secure connections.

CO4: Apply intrusion detection/prevention systems (IDS/IPS) and firewall configurations to mitigate network security threats.

CO5: Utilize network security monitoring tools (Wireshark, SIEM) to analyze network traffic and identify security incidents.

Textbooks:

1. William Stallings, “*Cryptography and Network Security: Principles and Practice*”, 7th Edition, Pearson Education Limited, 2017

Reference Books:

1. William Stallings and Michael Brown, “*Network Security Essentials: Applications and Standards*”, 4th Edition, Pearson Education Limited, 2011
2. Matt Bishop, “*Computer Security: Art and Science*”, 2nd Edition, Pearson Education Limited, 2009

Web Links:

1. Public key encryption: <https://www.khanacademy.org/computing/computers-and-internet/xcae6f4a7ff015e7d:online-data-security/xcae6f4a7ff015e7d:data-encryption-techniques/a/public-key-encryption>
2. Transport Layer Security: https://developer.mozilla.org/en-US/docs/Web/Security/Transport_Layer_Security
3. 10 Risk Factors: <https://securityscorecard.com/blog/securityscorecard-10-risk-factors-explained/>
4. SIEM Guide: <https://www.elastic.co/guide/en/siem/guide/index.html>

MACHINE LEARNING			
Semester	II	CIE Marks	50
Course Code	24MCPE553	SEE Marks	50
Teaching Hrs./Week (L: T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Familiarize with the core concepts of Machine Learning.
2. Impart knowledge to apply common supervised learning algorithms to solve classification and regression problems.
3. Provide knowledge on techniques essential to uncover hidden patterns and structures within unlabeled data.
4. Familiarize with Multilayer Perceptron via back propagation algorithm to solve classification problems.
5. Provide knowledge on Reinforcement learning techniques.

Module 1: Introduction to Machine Learning

No. of Hrs: 06+04

Introduction, Examples of Machine Learning Applications: Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning, Data Preparation Tasks: Data Cleaning, Feature Selection, Data Transform feature engineering, Dimensionality Reduction, **Data Preparation:** Problems with Naive Data Preparation, Train and Test Dataset, K-Fold Cross validation, Data Cleaning: Basics of Data Cleaning, Outlier Identification and Removal, Marking and Remove Missing Data, Statistical Imputation.

Textbook 1 - Ch 1

Textbook 3 - Ch 3, 4

Laboratory Components:

1. Demonstrate the following concepts of data preprocessing techniques by using few datasets.
 - a. Identify and remove outliers using IQR and Local Outlier Factor methods.
 - b. Identify and remove missing values.
 - c. Selection of numerical and Categorical features.
 - d. Perform Data Transformation.

Module 2: Supervised Learning

No. of Hrs: 05+04

Learning Multiple Classes, Regression, Bayesian Decision Theory: Introduction, Classification,

Parametric Methods: Maximum Likelihood Estimation, Bernoulli Density, Multinomial Density, Gaussian (Normal) Density, Regression.

Textbook 1 - Ch 2, 3, 4

Laboratory Components:

2. Linear Regression (Prediction): Predict a continuous value based on a linear relationship with features.
3. Logistic Regression (Classification): Classify data points into two categories (0 or 1) based on features.

Module 3: Unsupervised Learning

No. of Hrs: 05+06



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Clustering: Introduction, Mixture Densities, k-Means Clustering, Hierarchical Clustering,

Nonparametric Methods: Nonparametric Density Estimation, Histogram Estimator, Kernel Estimator, k-Nearest Neighbor Estimator, Decision Trees: Introduction, Univariate Trees, Classification Trees.

Textbook 1 - Ch 7,8,9

Laboratory Components:

4. K-Nearest Neighbors (KNN) – Classification: Classify data points based on the majority vote of their K nearest neighbors.
5. Decision Tree - Classification: Classify data points based on a tree-like structure with decision rules.

Module 4: Multilayer Perceptrons

No. of Hrs:05+04

Introduction, Understanding the Brain, Neural Networks as a Paradigm for Parallel Processing, The Perceptron, Training a Perceptron, Multilayer Perceptron, Backpropagation Algorithm, Nonlinear Regression, Two-Class Discrimination, Multiclass Discrimination.

Textbook 1 - Ch 11

Laboratory Components:

6. Perceptron: Implement a perceptron and train it to perform classification for a given problem.

Module 5: Reinforcement Learning

No. of Hrs: 05+06

Elements of Reinforcement Learning, Model-Based Learning, Value Iteration, Temporal Difference Learning, Exploration Strategies, Deterministic Rewards and Actions, Nondeterministic Rewards and Actions, Eligibility Traces, Generalization.

Textbook 1 - Ch 16

Laboratory Components:

7. Develop a reinforcement learning agent to control a car on a hill to reach the flag at the top.

Course Outcomes:

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

CO1: Summarize the appropriate machine learning paradigm for a given problem.

CO2: Utilize supervised learning models to make predictions based on labeled data.

CO3: Identify meaningful insights from unlabeled data through clustering.

CO4: Apply Multilayer Perceptron to solve classification problems.

CO5: Outline the different reinforcement learning techniques.

Textbooks:

1. Ethem Alpaydin, “*Introduction to Machine Learning*”, 4th Edition, MIT Press, Prentice Hall of India, 2020
2. Andreas C. Müller and Sarah Guido, “*Introduction to Machine Learning with Python A Guide for Data Scientists*”, 4th Edition, O'Reilly Media, Inc, 2017
3. Jason Brownlee, “*Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python*”, 2nd Edition, Machine Learning Mastery, 2020



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Reference Books:

1. Tom Mitchell, “Machine Learning”, 1st Edition, McGraw Hill, 2017
2. George F Luger, “Artificial Intelligence: Structures and Strategies for Complex Problem Solving”, 6th Edition, Pearson Education, 2021
3. Stephen Marsland, “Machine Learning - An Algorithmic Perspective”, 2nd Edition, CRC press, 2018

Web Links:

1. Machine Learning Tutorial: https://www.tutorialspoint.com/machine_learning/index.htm
2. A Brief Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc23_cs18/preview
3. Machine Learning Full Course: <https://www.youtube.com/watch?v=GwIo3gDZCVQ>
4. Data Preparation for Machine Learning in Python: <https://www.youtube.com/watch?v=ICoiTcY2uFY>



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NATURAL LANGUAGE PROCESSING

Semester	II	CIE Marks	50
Course Code	24MCPE554	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Familiarize the basic concepts of Natural Language Processing.
2. Impart knowledge on word levels and syntactic analysis.
3. Provide knowledge on semantic and disclosure process levels of NLP analysis.
4. Familiarize with Natural Language Generation and Machine translation techniques.
5. Impart knowledge on various applications of NLP.

Module 1 : Overview	No. of Hrs: 06+06
Overview and language modelling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modelling: Various Grammar - based Language Models-Statistical Language Model.	
Textbook 1 – Ch 1	
Laboratory Components:	
<ol style="list-style-type: none"> 1. Develop a grammar checker that identifies and suggests corrections for grammatical errors in English sentences using rule-based or statistical methods. 2. Build a toolkit that includes basic processing tasks (tokenization, stemming, POS tagging) for Indian languages such as Hindi or Bengali. 	
Module 2 : Word level and syntactic Analysis	No. of Hrs: 05+04
Word level and Syntactic Analysis: Word Level Analysis: Regular Expressions-Finite- State Automata-Morphological Parsing-Spelling Error Detection and Correction-Words and Word classes-Part-of Speech Tagging.	
Syntactic Analysis: Context-free Grammar- Constituency- Parsing-Probabilistic Parsing.	
Textbook 1 – Ch 2, 3	
Laboratory Components:	
<ol style="list-style-type: none"> 3. Implement a program that detects and corrects spelling errors in a text corpus using techniques like edit distance and dictionary lookup. 	
Module 3 : Semantic Analysis and Discourse Processing	No. of Hrs: 05+06
Semantic Analysis: Introduction, Meaning representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.	
Discourse Processing: Introduction Cohesion, Reference Resolution, Discourse Coherence and Structure.	



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Textbook 1 – Ch 4, 5

Laboratory Components:

4. Create a system that disambiguates word senses in context using WordNet or other lexical resources and algorithms like Lesk's method.
5. Implement a coreference resolution system that identifies and links pronouns and named entities to their referents across a document.

Module 4 : Natural Language Generation and Machine Translation

No. of Hrs: 05+04

Natural Language Generation: Architectures of NGL Systems, Generation tasks and representations, Applications of NGL

Machine Translation: Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Direct Machine Translations, Rule - based Machine Translation, Corpus-based Machine Translation.

Textbook 1 – Ch 6, 7

Laboratory Components:

6. Develop a machine translation system that translates text between English and a chosen Indian language (e.g., Hindi) using statistical methods or neural networks.

Module 5 : Information Retrieval & Applications

No. of Hrs: 05+04

Information Retrieval and Other Applications: Information Retrieval:

Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval, Evaluation of the IR System, NLP in IR, Relation Matching, Knowledge based Approaches, Conceptual Graphs in IR. Other Applications: Information extraction, Automatic Text Summarization.

Textbook 1 – Ch 8, 9, 10

Laboratory Components:

7. Design and implement an information retrieval system that allows users to search and retrieve relevant documents using techniques like vector space models and relevance feedback.

Course Outcomes:

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

CO1: Apply Natural Language Modelling Approaches to a variety of applications.

CO2: Make use of Word level, Syntactic level, Semantic level analysis on a few applications.

CO3: Utilize Semantic level semantic and disclosure process levels of NLP analysis.

CO4: Apply the machine translation approaches to a few problems.

CO5: Identify the different design models of Information Retrieval Systems and use it in certain scenarios.

Textbooks:

1. Tanveer Siddiqui, U.S. Tiwary, “*Natural Language Processing and Information Retrieval*”, Oxford University Press, 2008



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Reference Books:

1. Daniel Jurafsky and James H Martin, “*Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*”, 2nd Edition, Prentice Hall, 2008
2. James Allen, “*Natural Language Understanding*”, 2nd Edition, Benjamin/Cummings publishing company, 1995
3. Gerald J. Kowalski and Mark.T. Maybury, “*Information Storage and Retrieval systems*”, Kluwer academic Publishers, 2000

Web Links:

1. Introduction to Natural Language Processing:
<https://www.youtube.com/watch?v=6P2z9PDRWTw>
2. NLP with Deep Learning: https://www.youtube.com/watch?v=OQQ-W_63UgQ
3. NLP Syntactic Analysis:
https://www.tutorialspoint.com/natural_language_processing/natural_language_processing_syntactic_analysis



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MINI PROJECT

Semester	II	CIE Marks	50
Course Code	24MCSE526	SEE Marks	50
Teaching Hrs/Week(L:T:P)	0:0:2	Exam Hrs	2.5
Total Hrs	26	Credits	01

Course Learning Objectives:

This course is designed to

1. Recall the concepts learnt in Database Management Systems Course and using those concepts in application development.
2. Use the required tools and techniques to develop the mini project.
3. Examine the requirements of a mini project and transform them to a software module(s).
4. Impart skills to convert the software module to a pucca application.
5. Formulate the test cases for the project work.

The Mini Project is based on implementation of concepts and theory learnt in programming languages and DBMS. The sample project titles are listed as follows.

1. Barcode Generation
2. Bank software for an ATM
3. Load Shedding in mobile systems
4. Document Security System
5. Project Planning and Management
6. Library Information System
7. College Enrolment System
8. Resilient online coverage for surveillance applications
9. Employee information and Payroll System
10. Any other application or a system

Guidelines:

- Students will carry out the mini project using DBMS and programming languages or a machine learning project or any other project with what they have learnt in the last semester or currently learning this semester.
- A team of two students should develop the mini project. However, during the examination, each student must demonstrate the project individually.
- A brief mini-project report(20-25 pages) should be submitted, the report should include Introduction, Requirements of the Mini project, Design, Implementation and Testing.
- A synopsis needs to be submitted by the team as per the specified format. The format will be shared by the department. Students should perform a prior literature search before submitting their synopsis for the mini project.
- Final evaluation will be done through project demonstration and presentation.
- The marks of the mini project would be given on the basis of performance in CIE and SEE.



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Rubrics for Mini Project Evaluation CIE & SEE:

	Review #	Agenda	Assessment	Review Assessment Weightage	Overall Weightage		
Review 1 (R1)	Mid-Term Project Evaluation	Rubrics 1	25	50 (Sum of R1 & R2)	50		
	Final Internal Project Evaluation	Rubrics 2	25				
Final SEE Project Viva-Voce	End-Semester Project Evaluation		50	50			
Total				100			

Rubrics 1 (25 marks)

Criteria	Description	Marks (50)
Problem Definition & Relevance	Clarity of problem statement and justification	10
Background Study / Literature Review	Coverage of related work, understanding of existing methods, gaps identified	15
Objectives & Planning	Clear objectives, scope defined, feasibility plan and study and timelines	15
Preparation of Report - 1	Initial preparation of report with basic things like problem definition, related work and existing methods with references	10
	Total Marks	50

Rubrics 2 (25 marks)

Criteria	Description	Marks (50)
Technical Implementation / Methodology	Appropriateness of algorithms, coding standards, use of tools/technologies	10
Results / Intermediate Outputs	Progress achieved, partial results, testing efforts	15
Presentation & Team Contribution	Clarity in presentation/demo, Q & A, Contribution of team members	15
Preparation of Report - 2	Structure (Abstract, Introduction, Methodology, Results, Conclusion, References), formatting, flow	10
	Total Marks	50



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Course Outcomes:

CO1: Apply computing concepts on the selected problem domain

CO2: Identify the requirements/objectives of the problem in hand

CO3: Design and investigate the problems to arrive at conclusions

CO4: Implement using different software tools and technologies

CO5: Technically communicate effectively as an individual/team in projects

WEB LINKS:

- https://www.youtube.com/watch?v=ejhtUjuJ_is
- <https://www.youtube.com/watch?v=GdHQt8oFMsA>
- <https://www.youtube.com/watch?v=7v2OnUti2eM>
- <https://www.youtube.com/watch?v=e8g9eNnFpHO>
- <https://www.youtube.com/watch?v=9rTJa4l8YQ0>



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III SEM

CLOUD COMPUTING			
Semester	III	CIE Marks	50
Course Code	24MCPC611	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Familiarize the foundational concepts of cloud computing, service and deployment models and the essential characteristics of a cloud infrastructure.
2. Impart knowledge on core cloud services, infrastructure and virtualization.
3. Disseminate the concepts of containerization, microservices for cloud application deployment and DevOps practices.
4. Provide knowledge on cloud security challenges, Identity and Access Management, data protection and compliance strategies to secure cloud environments.
5. Familiarize advanced cloud topics including edge and fog computing, cost metrics and pricing models.

Module 1: Introduction to Cloud Computing

No. of Hrs: 10

Overview of Cloud Computing: Definition, History, Cloud characteristics: On-Demand Usage, Ubiquitous access, Multitenancy, Elasticity, Measured Usage, Resiliency, **Cloud Delivery Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Examples and use cases of each model, Comparing Cloud Delivery Models, Combining Cloud Delivery Models, **Cloud Deployment Models:** Public, Private, Multi Clouds, Hybrid Clouds.

Textbook 1- Ch 3,4

Module 2: Cloud Infrastructure and Services

No. of Hrs: 08

Virtualization Technology: Operating System-Based Virtualization, Hardware-Based Virtualization, Containers and Application-Based Virtualization, **Cloud Infrastructure Mechanisms:** Logical Network Perimeter, Virtual Server, Hypervisor, Cloud Storage Device, Cloud Usage Monitor, Resource Replication. **Case Study:** Understanding services from major providers (Google Cloud, Microsoft Azure)

Textbook 1- Ch 5, 8

Textbook 2 – Ch 9

Module 3: Cloud Containers and its Deployment

No. of Hrs: 08

Containerization and Microservices: Introduction to Docker and Kubernetes, Benefits and uses of containers in cloud computing. **Application Deployment on the Cloud:** CI/CD pipelines, and DevOps in cloud environments, Deploying Infrastructure as Code with CI/CD Pipelines.

Textbook 4 – Ch 1, 8, 9, 10

Module 4: Cloud Security and Compliance

No. of Hrs: 08

Data security and storage: Aspects of data security, Data Security Mitigation, Provider data and its security, **Audit and compliance:** Internal Policy Compliance, Governance, risk and compliance, Illustrative control objectives for Cloud computing.

Textbook 3 – Ch 4, 5, 8

Module 5: Emerging Trends in cloud computing

No. of Hrs: 08



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Edge and Fog Computing: Edge computing architecture, Fog computing architecture, Use cases of edge and fog computing in IoT. **Cost Metrics and Pricing Models:** Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations.

Textbook 1 – Ch 15, 17

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

- CO1:** Summarize the foundational principles of cloud computing.
- CO2:** Apply the concepts of virtualization techniques, cloud infrastructure components and core services to recommend solutions from major cloud providers for business needs.
- CO3:** Utilize Docker and Kubernetes to build, deliver, and scale containerized applications and use them in CI/CD pipelines to automate its deployment.
- CO4:** Make use of data security measures and compliance protocols to protect provider data, control access, and uphold governance in cloud environments.
- CO5:** Utilize edge and fog computing concepts for IoT use cases and assess business and cloud usage cost metrics along with cost management considerations.

Textbooks:

1. Thomas Erl and Eric Barceló Monroy, “*Cloud Computing: Concepts, Technology, Security & Architecture*”, 2nd Edition, Pearson Education, 2023
2. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, “*Mastering Cloud Computing Foundations and Applications Programming*”, 1st Edition, Morgan Kaufmann Publishers, 2013
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “*Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*”, 1st Edition, O'Reilly Media, 2009
4. Mikael Krief, “*Learning DevOps*”, 2nd Edition, Packt Publishing, 2022

Reference Books:

1. Michael J. Kavis, “Architecting the Cloud: Design Decisions for Cloud Computing Service Models”, 1st Edition, Wiley, 2014.
2. Nigel Poulton, “*Docker Deep Dive: Zero to Docker in a Single Book*”, 1st Edition, Packt Publishing, 2023.
3. Kelsey Hightower, Joe Beda, Brendan Burns, “*Kubernetes Up & Running: Dive into The Future of Infrastructure*”, 3rd Edition, Shroff publisher, 2022.

Web Links:

1. Cloud Computing Basics: <https://www.youtube.com/watch?v=64-1ymY2xaw>
2. Cloud Computing Full Course: <https://www.youtube.com/watch?v=2LaAJq1Lb1Q>
3. Cloud computing tutorial for beginners: <https://www.pragimtech.com/blog/cloud/cloud-tutorial-for-beginners/>
4. Introduction to Cloud Computing: <https://www.coursera.org/learn/introduction-to-cloud>
5. Docker Containers and Kubernetes Fundamentals: <https://www.youtube.com/watch?v=kTp5xUtcaww>
6. Cloud computing: <https://archive.nptel.ac.in/courses/106/105/106105167/>



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ADVANCED JAVA					
Semester	III	CIE Marks	50		
Course Code	24MCPC612	SEE Marks	50		
Teaching Hrs/Week (L:T:P)	3:0:2	Exam Hrs	03		
Total Hrs	50 (26 Theory + 24 Lab)	Credits	04		
Course Learning Objectives:					
This course is designed to					
<ol style="list-style-type: none"> 1. Impart fundamental knowledge and skills to build user interfaces (Uis) for Java applications. 2. Familiarize the process of retrieving, manipulating, and persisting data in a database. 3. Provide skills to utilize collections and generics effectively in Java programs. 4. Familiarize the concepts of scalable and maintainable enterprise applications using Spring Boot Framework. 5. Instill Hibernate concepts to map Java objects to relational database tables and perform CRUD operations. 					
Module 1: Advanced Java and Swing		No. of Hrs: 06+04			
Introduction to Advanced Java, Overview of AWT components, Event handling, Swing Overview, Basic Swing Components, Containers and Event Handling, Exploring Swing.					
Textbook 1: Ch 25, 26, 32, 33					
Laboratory Components					
<ol style="list-style-type: none"> 1. Build a simple GUI application using JButton, JTextField, and JLabel. Set up event listeners to handle button clicks and user inputs. 2. Create an application using multiple layouts (GridLayout, BorderLayout). Implement forms and menus. 3. Build an application using JTable, JTree, and Dialogs. Implement data binding between GUI and backend logic. 					
Module 2: Database Connectivity using JDBC		No. of Hrs:04+06			
Concepts of JDBC, JDBC Process, Database Connection, Statement Objects, ResultSet, Transaction Processing, Metadata.					
Textbook 2: Ch 6					
Laboratory Components					
<ol style="list-style-type: none"> 4. Set up JDBC to connect to a MySQL/PostgreSQL database. Perform basic CRUD operations using CallableStatement and PreparedStatement. 5. Implement a transaction with commit and rollback in a banking or inventory application. 6. Retrieve database metadata, table structure, and execute stored procedures. 					
Module 3: Collections Framework and Generics		No. of Hrs: 06+04			
Introduction to Collections: Overview, The Collection Interfaces, The Collection Classes, Accessing a Collection via an Iterator, Storing User-Defined Classes in Collections, Comparators.					
Generics in Java: Generics Example, Implementing Generic classes and methods, Using Wildcard Arguments, Generic Interfaces, Type Inference with Generics					
Textbook 1: Ch 14, 20					



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Laboratory Components

7. Implement programs that demonstrate the usage of List, Set, and Map with different data types.
8. Develop a simple Generic class and perform operations using Collections with Generics.
9. Write a program that uses Comparable and Comparator for custom sorting, using a PriorityQueue.

Module 4: Spring Boot for Enterprise Java Applications

No. of Hrs: 06+04

Introduction to Spring Boot, Spring Boot REST API Development, Spring Boot Data Access with JPA, Application Development with Spring MVC, Reactive Programming.

Textbook 3: Ch 1, 3, 6, 7, 8

Laboratory Components

10. Create a basic Spring Boot project and develop REST APIs.
11. Implement a data access layer using Spring Data JPA to interact with a database. Perform CRUD operations through REST APIs.
12. Add exception handling and logging to the Spring Boot application for better error management and traceability.

Module 5: Hibernate ORM for Object-Relational Mapping

No. of Hrs: 04+06

Introduction to Hibernate, Hibernate configuration, Mapping collections and entity associations, Advanced entity association mappings, Creating and executing queries, Hibernate Query Language (HQL).

Text book 4: Ch 2 ,7, 8, 14, 15

Laboratory Components

13. Set up Hibernate with MySQL/PostgreSQL and perform basic CRUD operations.
14. Map Java classes to database tables and implement relationships (One-to-Many, Many-to-Many).
15. Write HQL queries to retrieve data, implement filtering, sorting, and joins using HQL.

Course Outcomes:

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

CO1: Design and implement user-friendly graphical user interfaces using Java extensions.

CO2: Apply database operations such as data retrieval, manipulation, and storage by integrating Java with databases.

CO3: Make use of Java Collections to store, sort, and search data also apply Generics to ensure type safety.

CO4: Design simple and scalable enterprise-level applications by utilizing the Spring Boot framework.

CO5: Apply Hibernate ORM to map Java objects to relational database tables and perform CRUD operations effectively.



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Textbooks:

1. Herbert Schildt and Dr. Danny Coward, “*Java: The Complete Reference*”, 13th Edition, McGraw-Hill, 2024
2. Jim Keogh, “*J2EE: The Complete Reference*”, McGraw-Hill, 2017
3. Mark Heckler, “*Spring Boot: Up and Running – Building Cloud Native Java and Kotlin Applications*”, O'Reilly Media, 2021
4. Christian Bauer, Gavin King and Gary Gregory, “*Java Persistence with Hibernate*”, 2nd Edition, Manning Publications, 2015

Reference Books:

1. Cay S. Horstmann, “*Core Java Volume II – Advanced Features*”, 12th Edition, Prentice Hall, 2018.
2. D.T. Editorial Services, “*Java 8 Programming Black Book*”, Dreamtech Press, 2005.
3. Catalin Tudose, “*Java Persistence With Spring Data and Hibernate*”, Manning Publications, 2023.
4. Uttam K Roy, “*Advanced Java Programming*”, Oxford University Press, 2015.

Web Links:

1. Java Database Connectivity JDBC: <https://www.youtube.com/watch?v=h5sbJxeHqOY>
2. Advanced Java Tutorial: <https://www.edureka.co/blog/advanced-java-tutorial>
3. Advanced Java Programming: https://www.youtube.com/watch?v=I_qP7H3STMg
4. Spring Boot Tutorial: <https://www.youtube.com/watch?v=9SGDpanrc8U>
5. Hibernate Tutorial For Beginners: <https://www.youtube.com/watch?v=0KCKBv6rbkc>

ETHICAL HACKING

Semester	III	CIE Marks	50
Course Code	24MCPE651	SEE Marks	50
Teaching Hrs/Week (L: T: P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Instill the basics of penetration tools and methodologies used in ethical hacking.
2. Impart knowledge in analyzing the vulnerabilities and attacks on a system.
3. Provide knowledge on exploitation and attacks.
4. Familiarize with the process of phishing attacks.
5. Impart knowledge on web application vulnerabilities, focusing on SQL injection.

Module 1: Introduction to Penetration Testing

No. of Hrs: 06+04

Stages of Penetration Test: Pre-engagement, Information gathering, Threat modeling, Vulnerability analysis, Exploitation, Post exploitation, Reporting, Kali Linux: User privileges, Data manipulation, Managing networking, Metasploit framework: Finding Metasploit modules, Setting module options, Payloads, Types of Shells, Setting a payload manually.

Textbook 1: Ch 0, 2, 4

Laboratory Components:

1. Perform network scanning to identify vulnerabilities and services on a target system.
2. Analyze port states and identify security implications.

Module 2: Information Gathering and Vulnerabilities

No. of Hrs: 05+04

Netcraft, Whois LookUps, DNS Reconnaissance, Searching for Email Addresses, Maltego. Port Scanning: Manual port scanning, Port scanning with Nmap, Finding vulnerabilities: Nessus policies, Exporting Nessus results, Researching Vulnerabilities, The Nmap Scripting Engines, Metasploit Scanner Modules.

Textbook 1 : Ch 5, 6

Laboratory Components:

3. Perform reconnaissance on a network, gathering publicly available information and scanning for vulnerabilities.
4. Implement advanced network scanning techniques to identify operating systems, services, and open ports.

Module 3: Exploitation and Attacks

No. of Hrs: 05+06

Metasploit payloads, Exploiting WebDAV Default Credentials: Running a script on the target web server, Password attacks, Client-side exploitation: HTTP and HTTPS Payloads, Client-Side attacks, Wireless attacks: Viewing available wireless interfaces, Capturing packets, Wired equivalent privacy, WiFi Protected access, WPA2: The Enterprise Connection Process, The personal connection process, WiFi-protected setup.

Textbook 1: Ch 8, 9, 10, 15



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Laboratory Components:

5. Simulate wireless attacks to test WPA/WPA2 network vulnerabilities.
6. Analyze and execute a DoS attack on a vulnerable system (in a controlled environment).

Module 4: Social Engineering

No. of Hrs: 05+06

The Social Engineering toolkit, Spear Phishing attacks: Choosing a payload, Single or mass mail, Creating a template, Setting up target and listener, Web attacks, Mass email attacks, Multipronged attacks, A Sophisticated and Sneaky Social Engineering Attack, Faking Emails: Performing a DNS Lookup of a Mail Server, Communicating with SMTP, Writing an Email Spoof, Spoofing SMTPS Emails, Faking Websites.

Textbook 1: Ch 11, T2: Ch 7

Laboratory Components:

7. Simulate a spear phishing attack to assess the security awareness of a target organization.
8. Simulate an Email Spoofing Attack to Evaluate Email Security Measures.

Module 5: Web Application Testing

No. of Hrs: 05+04

SQL Injection, Xpath Injection, Local File Inclusion, Remote File Inclusion, Command Execution, Cross-Site Scripting, Cross-Site Request Forgery, Web Application Scanning with w3af.

Textbook 1: Ch 14

Laboratory Components:

9. Test a web application for SQL injection vulnerabilities and propose mitigation strategies.
10. Conduct a cross-site scripting (XSS) attack to demonstrate how malicious code can be injected..

Course Outcomes:

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

CO1: Apply penetration testing techniques to identify vulnerabilities and weaknesses in systems.

CO2: Implement basic scripting to connect to a port and scan the network and host.

CO3: Demonstrate the process of payload injection and utilization.

CO4: Identify the process of phishing attacks and assess the security levels involved given a scenario.

CO5: Execute tests to identify and evaluate web application vulnerabilities, focusing on SQL injection.

Textbooks:

1. Georgia Weidman, “*Penetration Testing: A Hands-On Introduction to Hacking*”, No Starch Press, 2014
2. Daniel G. Graham, “*Ethical Hacking: A Hands-On Introduction to Breaking In*”, No Starch Press, 2021

Reference Books:

1. Dafydd Stuttard, Marcus Pinto, “*The Web Application Hacker’s Handbook: Discovering and Exploiting Security Flaws*”, Wiley Publishing, 2nd Edition, 2011
2. Michael T. Simpson, Kent Backman, and James E. Corley, “*Hands-On Ethical Hacking and Network Defense*”, 2nd Edition, Cengage Learning, 2011



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Web Links:

1. Ethical Hacking (Udemy):
<https://www.udemy.com/course/learn-ethical-hacking-and-penetration-testing-online>
2. Ethical Hacking Essentials: <https://www.coursera.org/learn/ethical-hacking-essentials-ehe>
3. Ethical Hacking(edx): <https://www.edx.org/learn/ethical-hacking>



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DIGITAL FORENSICS			
Semester	III	CIE Marks	50
Course Code	24MCPE652	SEE Marks	50
Teaching Hrs/Week (L: T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
Course Learning Objectives:			
This course is designed to			
<ol style="list-style-type: none"> 1. Impart knowledge on computer forensics, including its principles, methodologies, and role in modern investigative processes. 2. Familiarize in conducting systematic investigations and executing detailed forensic analysis. 3. Provide the ethical and legal principles required for conducting investigations related to cybercrimes. 4. Instill the ability to critically review and analyze digital evidence, fostering the development of effective investigative strategies. 5. Provide knowledge to apply ethical and legal principles in conducting email investigations, ensuring compliance with privacy regulations and chain of custody requirements. 			
Module 1: Computer forensics fundamentals			No. of Hrs: 08
An Overview of Digital Forensics, Preparing for Digital Investigations, Maintaining Professional Conduct, Preparing a Digital Forensics Investigation, Procedures for Private-Sector High-Tech Investigations, Understanding Data Recovery Workstations and Software, Conducting an Investigation.			
Textbook 1 – Ch 1			
Module 2: Data Acquisition			No. of Hrs: 08
Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Using Acquisition Tools, Validating Data Acquisitions, Performing Raid Data Acquisitions, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools.			
Textbook 1 – Ch 3			
Module 3: Processing Crimes and Incident Scenes			No. of Hrs: 08
Identifying Digital Evidence, Collecting evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes, Preparing for a Search, Securing a Digital Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash, Reviewing a Case.			
Textbook 1 – Ch 4			
Module 4: Current Digital Forensics Tools			No. of Hrs: 10
Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software, E-Mail Investigations: Investigating Email Crime and Violations, Understanding E-Mail Servers, Using Specialized E-Mail Forensics Tool, Applying Digital Forensics Methods to Social Media Communications.			
Textbook 1 – Ch 6, Ch 11			
Module 5: Digital Forensics Analysis, Validation and Virtual Machine Forensics			No. of Hrs: 8



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Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, An Overview of Virtual Machine Forensics, Performing Live Acquisitions, Network Forensics Overview.

Textbook 1 – Ch 9, Ch 10

Course Outcomes:

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

CO1: Identify the fundamental concepts in computer forensics and its associated systems.

CO2: Apply systematic approaches to conduct the systematic investigations and executing detailed Forensic analyses.

CO3: Use the different data acquisition methods and choose an appropriate approach for a given case.

CO4: Solve a forensics case with the available digital evidence and using the appropriate strategies.

CO5: Apply ethical and legal principles in conducting email investigations and ensuring compliance with privacy regulations

Textbooks:

1. Bill Nelson, Amelia Phillips, Chris Stuart, “*Guide to Computer Forensics and Investigations*”, Thomson Course Technology, 6th Edition, 2018

Reference Books:

1. John R Vacca, Computer Forensics, “*Computer Crime Scene Investigation*”, Charles River Media, 2nd Edition, 2005
2. John Sammons, “*The basics of digital forensics: The primer for getting started in digital forensics*”, Elsevier Science, 2014
3. Linda Volonino, Reynaldo Anzaldua, and Jana Godwin, “*Computer Forensics: Principles and Practices*”, Pearson, 2007

Web Links:

1. Computer Forensics Specialization : <https://www.coursera.org/specializations/computerforensics>
2. Digital Forensics and Electronic Evidence:
<https://www.udemy.com/course/digital-forensics-and-electronic-evidence>
3. Cyber Forensics : <https://www.mygreatlearning.com/academy/learn-for-free/courses/cyber-forensics>

DEEP LEARNING

Semester	III	CIE Marks	50
Course Code	24MCPE653	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Impart knowledge on the mathematical, statistical and computational challenges of building neural networks.
2. Provide computational knowledge on deep neural networks.
3. Disseminate the benefits of CNN in various solutions.
4. Familiarize the uses and applications of Autoencoders in different real time problems.
5. Impart deep learning skills and techniques to develop and optimize real-time applications.

Module 1 : Foundation of Neural Networks and Deep Learning	No. of Hrs: 06+04
Mathematical foundation in Neural networks. Neural Networks: The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks. Training Neural Networks: Backpropagation Learning. Activation Functions, Loss Functions. Hyperparameters: Learning Rate, Momentum. Introduction to Deep Learning.	
Textbook 1 – Ch 1, 2	
Laboratory component	
<ol style="list-style-type: none"> 1. Implement a simple feed-forward neural network (using NumPy) that can classify a dataset (e.g., the Iris dataset or a simple binary classification dataset). 2. Create a neural network that utilizes different activation functions and evaluate their performance on a classification task. 	
Module 2: Deep Neural Networks	No. of Hrs: 05+06
Common Architectural Principles of Deep Networks: Parameters, Layers, Activation functions, Loss functions, Optimization methods. Hyperparameters: Magnitude (momentum, learning rate), Regularization (dropout, drop connect, L1, L2), Weight initialization strategy, Settings for epochs during training (mini-batch size), Normalization scheme for input data, Building Blocks of Deep Networks.	
Textbook 1 – Ch 3	
Laboratory component	
<ol style="list-style-type: none"> 3. Implement a deep feedforward neural network using a framework incorporating various regularization techniques to evaluate their effects on model performance. 4. Implement a program to investigate the effect of different optimization techniques on the training of a deep neural network for a regression or classification task. 	
Module 3: Convolutional Neural Networks	No. of Hrs: 05+04



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Unsupervised Pretrained Networks: Autoencoders, Deep Belief Networks (DBNs).

Convolutional Neural Networks (CNNs), Biological Inspiration, Intuition, CNN Architecture Overview, Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers, Other Applications of CNNs.

Textbook 1 – Ch 4

Laboratory component

5. Develop a CNN to classify images from a dataset and evaluate its performance compared to a basic feed-forward neural network.

Module 4: Recurrent Neural Networks

No. of Hrs: 05+04

Modeling the Time Dimension, 3D Volumetric Input, Markov Models, General Recurrent Neural Network Architecture, LSTM Networks, Domain-Specific Applications and Blended Networks, Network Architecture, Varieties of Recursive Neural Networks, Applications of Recursive Neural Networks.

Textbook 1 – Ch 4

Laboratory component

6. Create an RNN to perform a sequence prediction task, such as predicting the next character in a sequence or generating text based on a seed input.

Module 5 : Deep Learning

No. of Hrs: 05+06

Linear Factor Models: Probabilistic PCA and Factor Analysis, Independent Component Analysis (ICA).

Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders.

Representation Learning: Greedy Layer-Wise Unsupervised Pre-Training, Transfer Learning and Domain Adaptation.

Textbook 2 – Ch 18

Laboratory component

7. Develop a program that implements Probabilistic Principal Component Analysis (PPCA) and Factor Analysis to analyze a dataset and visualize the results.
8. Create and evaluate different types of autoencoders, including under complete, regularized, and denoising autoencoders, to understand their functionalities and applications in representation learning.

Course Outcomes:

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

CO1: Outline the basics of mathematical foundation to build Deep Learning models.

CO2: Apply the concepts of deep networks in deep learning.

CO3: Apply the concepts of Convolutional Neural Networks to perform deep learning.

CO4: Utilize deep learning architectures for processing text & image data.

CO5: Make use of various deep learning techniques to design efficient algorithms for real-world applications.



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Textbooks:

1. Josh Patterson and Adam Gibson, “*Deep learning A Practitioner’s Approach*”, 1st Edition, O’Reilly, 2017
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “*Deep Learning*”, 1st Edition, An MIT Press book, 2016

Reference Books:

1. Deng & Yu, “*Deep Learning: Methods and Applications*”, 1st Edition, Now Publishers, 2013
2. Douwe Osinga, “*CookBook Deep Learning*”, 1st Edition, O’Reilly, 2017.

Web Links:

1. MATLAB for DeepLearning: <https://tinyurl.com/matlabfordl>
2. Neural Networks and Deep Learning: <https://tinyurl.com/neuralnetworkanddeeplearning>
3. Introduction to Deep Learning: <https://tinyurl.com/introdcutiontodeeplearning>
4. Deep Learning Course: <https://www.youtube.com/watch?v=lhufOy2W3Ps>

PATTERN RECOGNITION

Semester	III	CIE Marks	50
Course Code	24MCPE654	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to:

1. Impart knowledge on the fundamental concepts of the classification process.
2. Provide knowledge on how to apply statistics in pattern recognition.
3. Demonstrate nonparametric learning methods to understand the principles behind artificial neural networks and kernel machines.
4. Instill the basic principles of feature extraction in image processing.
5. Perform dimensionality reduction using varied techniques and estimate classifier performance.

Module 1: Fundamentals of Classification

No. of Hrs: 06 + 04

The Classification Process, Features, Training and Learning, Supervised Learning and Algorithm Selection, Approaches to Classification.

Non Metric Methods: Introduction, Decision Tree Classifier: Information, Entropy, and Impurity, Information Gain, Decision Tree Issues. Rule-Based Classifier.

Textbook 1 – Ch 2, 3

Laboratory Components

1. Implement a program to perform the following tasks:
 - a. Load a dataset (e.g., Iris dataset or any other classification dataset).
 - b. Implement a decision tree classifier using Scikit-Learn library.
 - c. Calculate and display the information gain, entropy, and impurity for each feature in the dataset.
 - d. Fit the decision tree model to the training data and visualize the tree structure using a plotting library (e.g., Matplotlib).
 - e. Evaluate the model's performance on a test dataset by calculating accuracy, precision, recall, and F1-score.
2. Write a program to perform the following tasks:
 - Load a dataset (e.g., the Titanic dataset or any relevant dataset).
 - Define classification rules based on specific features (e.g., age, gender, class) and implement a simple rule-based classifier.
 - Create a function that applies these rules to classify instances in the dataset (e.g., predicting survival based on rules).
 - Test the classifier on a subset of data and report the classification results.
 - Compare the performance of the rule-based classifier with that of a decision tree classifier using the same dataset and report findings.

Module 2: Statistics in Pattern Recognition

No. of Hrs: 05 + 04

Measured Data and Measurement Error, Probability Theory: Simple Probability Theory, Conditional Probability and Bayes' Rule, Naive Bayes Classifier. Continuous Random Variables: The Multivariate Gaussian, The Covariance Matrix, the Mahalanobis Distance.

Textbook 1 – Ch 4

Laboratory Components

3. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., the Iris dataset or any relevant dataset).
 - b. Preprocess the data by handling missing values and encoding categorical variables if necessary.
 - c. Implement a Naïve Bayes classifier using the following steps:
 - o Calculate the prior probabilities for each class.
 - o Calculate the likelihood of each feature given the class.
 - o Use Bayes' Rule to classify the instances in the test set.
 - d. Evaluate the performance of the classifier using metrics such as accuracy, precision, recall, and F1-score.
 - e. Visualize the results using a confusion matrix to illustrate the classification performance.
4. Write a program to perform the following tasks:
 - a. Load a multivariate dataset (e.g., a dataset with features like height, weight, and age).
 - b. Calculate the mean vector and covariance matrix of the dataset.
 - c. Implement a function to compute the Mahalanobis distance for each instance in the dataset.
 - d. Use the Mahalanobis distance to identify anomalies (instances that are significantly far from the mean).
 - e. Visualize the data points, the mean, and the identified anomalies on a scatter plot.

Module 3: Parametric and Nonparametric Learning

No. of Hrs: 05+06

Parametric Learning: Bayesian Decision Theory, Discriminant Functions and Decision Boundaries, MAP (Maximum A Posteriori) Estimator.

Nonparametric Learning: Histogram Estimator and Parzen Windows, k-Nearest Neighbour (k-NN) Classification, Artificial Neural Networks, Kernel Machines.

Textbook 1 – Ch 5, 6

Laboratory Components

5. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., a binary classification dataset like the Breast Cancer Wisconsin dataset or any relevant dataset).
 - b. Pre-process the data, handling any missing values or categorical variables as needed.
 - c. Implement the Bayesian decision technique for classification:
 - o Calculate prior probabilities and likelihoods for each class.
 - o Compute the posterior probability for each class using Bayes' Theorem.
 - d. Implement the Maximum A Posteriori (MAP) estimator to classify the data points.
 - e. Evaluate the performance of the classifier using metrics such as accuracy, precision, recall, and F1-score.
6. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., the Iris dataset or any other suitable dataset for classification).
 - b. Split the dataset into training and testing sets.
 - c. Implement the k-Nearest Neighbour (k-NN) classification algorithm:
 - o Calculate distances between the test instance and all training instances.
 - o Identify the k-nearest neighbours and perform majority voting to classify the test instance.
 - d. Implement a parametric learning approach, such as logistic regression, to classify the same dataset.
 - e. Compare the performance of the k-NN classifier with the parametric model using metrics such as accuracy, confusion matrix, ROC curve, and execution time.



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Module 4: Feature Extraction and Selection

No. of Hrs: 05+06

Reducing Dimensionality: Pre-processing, Feature Selection: Inter/Intra-class Distance, Subset Selection. Feature Extraction: Principal Component Analysis, Linear Discriminant Analysis.

Textbook 1 – Ch 7

Laboratory Components

7. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., the Iris dataset or any relevant dataset).
 - b. Preprocess the data by handling missing values and encoding categorical variables as necessary.
 - c. Implement a function to calculate inter-class and intra-class distances for the features:
 - o Calculate the mean feature vector for each class (intra-class).
 - o Calculate the overall mean feature vector (inter-class).
 - o Compute the distance metrics (e.g., Euclidean distance) to measure the separability of the classes.
 - d. Select the top features based on the calculated distances and create a new dataset with these selected features.
 - e. Train a classifier (e.g., logistic regression or decision tree) using the original dataset and the reduced dataset and compare their performance (e.g., accuracy, F1-score).
8. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., the MNIST dataset or any relevant dataset).
 - b. Preprocess the data by normalizing the features and encoding categorical variables if needed.
 - c. Implement Principal Component Analysis (PCA) to reduce the dimensionality of the dataset:
 - o Compute the covariance matrix, eigenvalues, and eigenvectors.
 - o Project the original data onto the selected principal components.
 - d. Implement Linear Discriminant Analysis (LDA) for dimensionality reduction:
 - o Calculate the within-class and between-class scatter matrices.
 - o Compute the eigenvectors and project the data onto the new LDA space.
 - e. Visualize the results using scatter plots for both PCA and LDA, showing how the data is distributed in the reduced dimensions.

Module 5: Estimating and Comparing Classifiers

No. of Hrs: 05 +04

Bias and Variance, Cross-Validation and Resampling Methods: The Holdout Method, k-Fold Cross-Validation, Bootstrap, Measuring Classifier Performance, Comparing Classifiers: ROC Curves. Combining Classifiers.

Textbook 1- Ch 9

Laboratory Components

9. Write a program to perform the following tasks:
 - a. Load a dataset (e.g., the Iris dataset or the Breast Cancer dataset or any relevant data).
 - b. Pre-process the data by handling missing values and normalizing features as needed.
 - o Implement k-fold cross-validation
 - o Split the dataset into k folds.
 - c. For each fold, train a classifier (e.g., Decision Tree, SVM, or Logistic Regression) on the training data and evaluate it on the validation data.
 - d. Record the performance metrics (accuracy, precision, recall, F1-score) for each fold.

- Calculate the mean and standard deviation of the performance metrics across all folds to assess bias and variance.

3. Visualize the performance metrics using box plots to illustrate the variance in classifier performance.

10. Write a program to perform the following tasks:

- a. Load a binary classification dataset (e.g., the Pima Indians Diabetes dataset or any relevant dataset).
- b. Pre-process the data as necessary, including normalization and handling missing values.
- c. Train at least three different classifiers (e.g., Random Forest, Logistic Regression, and k-NN) on the dataset.
- d. For each classifier, compute the ROC curve and the Area Under the Curve (AUC):
 - Use the predicted probabilities for the positive class to compute the ROC curve.
 - Plot the ROC curve for each classifier on the same graph.
- e. Implement a simple ensemble method (e.g., Voting Classifier or Stacking) to combine the predictions of the classifiers and compute its ROC curve and AUC.
- f. Compare the AUC values of individual classifiers and the ensemble method.

Course Outcomes:

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

CO1: Outline the fundamental concepts in pattern recognition.

CO2: Apply statistical pattern recognition techniques to solve problems.

CO3: Utilize parametric and nonparametric learning in pattern recognition.

CO4: Apply various feature extraction and selection techniques in pattern recognition.

CO5: Make use of different classifiers and compare their performance.

Textbooks:

1. Geoff Dougherty, “*Pattern Recognition and Classification, An Introduction*”, Springer, 2012.

Reference Books:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “*Pattern Classification*”, 2nd Edition, John Wiley, 2006.
2. S. Theodoridis and K. Koutroumbas, “*Pattern Recognition*”, 4th Edition, Academic Press, 2009.
3. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.

Web Links:

1. Introduction to Pattern Recognition Part I:
<https://www.youtube.com/watch?v=ZGULaomeJ-k>
2. Introduction to Pattern Recognition Part II:
https://www.youtube.com/watch?v=RFvHa_AK5gg
3. Introduction to Pattern recognition using Machine Learning:
<https://www.mygreatlearning.com/blog/pattern-recognition-machine-learning/>

SECURE SOFTWARE DEVELOPMENT

Semester	III	CIE Marks	50
Course Code	24MCPE661	SEE Marks	50
Teaching Hrs/Week (L: T:P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03

Course Learning Objectives:

This course is designed to

1. Familiarize with the fundamental security challenges in software and to manage them throughout the development process.
2. Impart knowledge to prioritize security requirements during the software engineering process.
3. Emphasize the need to apply architectural security practices and risk analysis to design secure software systems.
4. Instill proficiency in secure coding practices and security testing throughout the software development lifecycle.
5. Impart skills to apply governance and security management principles in ensuring secure software development within enterprises.

Module 1: Security as a Software Issue	No. of Hrs: 10
Introduction, Software Assurance and Software Security, Threats to Software Security, Sources of Software Insecurity, Benefits of detecting software security, Managing secure software development, What makes software secure: Defining properties of secure software, Influencing the security properties of software, Asserting and specifying desired security properties.	
Textbook 1 – Ch 1, 2	
Module 2: Requirements Engineering for Secure Software	No. of Hrs: 09
Introduction, Importance of Requirements Engineering for secure software, Quality Requirements, Security Requirements Engineering. Misuse and Abuse Cases: Creating useful misuse cases, An abuse case example, The SQUARE process model: Description, Tools, Expected results, Output from SQUARE process model, Requirements Elicitation, Requirements Prioritization.	
Textbook 1 – Ch 3	
Module 3: Secure Software Architecture and Design	No. of Hrs: 08
Introduction, Software Security Practices for Architecture and Design, Architectural Risk Analysis, Software Security Knowledge for Architecture and Design: Security Principles, Security Guidelines, Attack patterns.	
Textbook 1 – Ch 4	
Module 4: Secure Coding, Testing, Security and Software Complexity	No. of Hrs: 08
Introduction, Code Analysis, Coding Practices, Software Security Testing, Security testing considerations throughout the SDLC, Security failures, Functional and Attacker's perspectives for security analysis with examples, System complexity drivers and security.	
Textbook 1 – Ch 5, 6	
Module 5: Governance and Managing Secure Software	No. of Hrs: 07
Introduction, Governance and Security, Adopting an Enterprise Software Security framework, How much security is enough, Security and Project management, Maturity of Practice.	
Textbook 1 – Ch 7	

Course Outcomes:

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

CO1: Apply the principles of software assurance and software security and effectively manage secure software development practices.

CO2: Use standard practices for secure requirements engineering and identify misuse or abuse cases for a given scenario.

CO3: Apply secure architectural principles and attack patterns to enhance the security of software designs.

CO4: Use secure coding practices to build reliable and secure software applications.

CO5: Apply security governance principles into software project management and evaluate the maturity of security practices to determine the appropriate level of security.

Textbooks:

1. Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, and Nancy R. Mead, *Software Security Engineering : A Guide for Project Managers*, Addison-Wesley, 2008

Reference Books:

1. Michael Howard, Steve Lipner, *The Security Development Lifecycle: SDL, A Process for Developing Demonstrably More Secure Software*, Microsoft Press, 2006
2. Jason Grembi, *Secure Software Development: A Security Programmer's Guide*, Cengage Learning, 2020
3. Jan Jürjens, Flavio De Paoli, and Alexander Pretschner, *Engineering Secure Software and Systems*, Springer, 2020

Web Links:

1. The Cyber Security Body of Knowledge:
https://www.cybok.org/media/downloads/CyBOK_v1.1.0.pdf
2. Secure Software Design:
<https://www.udemy.com/course/secure-software-design-secure-software-series-course-3-of-8/?couponCode=LETSLEARNNOWPP>
3. Secure System Analysis and Design:
<https://www.futurelearn.com/courses/system-analysis-and-design-sc>

BLOCKCHAIN TECHNOLOGY

Semester	III	CIE Marks	50
Course Code	24MCPE662	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to

1. Impart fundamental knowledge of Blockchain Technologies and its architecture.
2. Familiarize the concepts of decentralization in blockchain using consensus algorithms.
3. Provide knowledge on Bitcoin's key management and transaction mechanisms.
4. Instill the knowledge on development and deployment of smart contracts on the Ethereum blockchain.
5. Provide knowledge on the applications of blockchain's role across different technologies.

Module 1: Fundamentals of Blockchain

No. of Hrs: 05+06

The growth of blockchain technology, Distributed systems, History of blockchain and Bitcoin, Blockchain Architecture, Generic elements of a blockchain, Benefits and limitations of blockchain, types of blockchain.

Textbook 1 – Ch 1

Laboratory Components:

1. Design a simple blockchain using Python or any other language of your choice that simulates the creation of blocks and chain formation.
2. Implement a simple blockchain that demonstrates the core generic elements: blocks, hash, nonce, previous hash, and transactions. Use python to simulate the creation, mining, and linking of blocks.

Module 2: Decentralization in Blockchain

No. of Hrs: 05+06

Methods of decentralization, Quantifying decentralization, Benefits of decentralization, Full-eco system decentralization, Decentralization in practice, Routes to decentralization, Cryptographic constructs used in blockchain, Consensus algorithms: CFT (Crash Fault Tolerance) algorithm, BFT (Byzantine Fault Tolerance) algorithm.

Textbook 1 – Ch 2, 5

Laboratory Components:

3. Implement a small-scale decentralized application (Dapp) using blockchain to demonstrate decentralization in practice.
4. Simulate the working of a consensus algorithm (CFT) using blockchain.

Module 3: Bitcoins and Transaction Processing

No. of Hrs: 04+06

Private and public keys in Bitcoin, Typical Bitcoin addresses, Transactions, Bitcoin payments, Bitcoin in practice, Alternative Coins, Bitcoin limitations.

Textbook 1 – Ch 6, 7

Laboratory Components

5. Using Bitcoin's public and private key infrastructure, simulate a basic transaction between two parties.

6. Simulate a Bitcoin payment by verifying a chain of transactions (inputs and outputs) and ensuring that the total inputs match the total outputs. Example:

- A sends 1 BTC to B.
- B uses this 1 BTC to send 0.5 BTC to C and 0.5 BTC back to B (change output).
- Verify each transaction in the chain.

Module 4: Smart Contracts and Ethereum

No. of Hrs: 05+06

Smart Contracts: Definition, Ricardian contracts, Smart contract templates, Deploying smart contracts, Ethereum keys and addresses, Accounts, Transaction and messages, Ethereum blockchain, Elements of Ethereum blockchain.

Textbook 1 – Ch 8, 9

Laboratory Components

7. Develop and deploy a simple smart contract using Solidity on the Ethereum test network.
8. Explore Ethereum 101 by creating an Ethereum wallet and executing a transaction on the test network.

Module 5: Blockchain and Allied Technology

No. of Hrs: 07

Block chain and Cloud Computing, Characteristics of Blockchain Cloud, Blockchain and Artificial Intelligence, Block chain and IoT, Blockchain and Machine Learning, Blockchain and Robotic Process Automation.

Textbook 2 – Ch 11

Course Outcomes:

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

CO1: Summarize the importance of distributed system's principles, blockchain technologies and bitcoins emphasizing their societal and economic significance.

CO2: Apply decentralization methods in blockchain ecosystems using cryptographic constructs and consensus algorithms.

CO3: Identify the payment system in Bitcoin using public and private key encryption.

CO4: Utilize the smart contract components and apply knowledge to develop and deploy contracts on the Ethereum blockchain.

CO5: Outline the applications of blockchain across different technologies.

Textbooks:

1. Imran Bashir, “*Mastering Blockchain – Inner Workings of blockchain, from cryptography and decentralized identities, to DeFI, NFTs and Web3*”, 4th Edition, Packt, 2024
2. Kumar Saurabh, Ashutosh Saxena, “*Blockchain Technology Concepts and Applications*”, Wiley India Pvt. Ltd, 1st Edition, 2023

Reference Books:

1. Mayukh Mukhopadhyay, “*Ethereum Smart Contract Development: Build Blockchain-Based Decentralized Applications Using Solidity*”, Packt, 2018
2. Roberto Infante, “*Building Ethereum Dapps: Decentralized Applications on the Ethereum Blockchain*”, Manning Publications, 2019



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Web Links:

1. De-centralization in blockchain: <https://www.angelone.in/knowledgcenter/cryptocurrency>
2. Introduction to Ethereum : <https://www.investopedia.com/terms/e/ethereum.asp>
3. Smart Contracts: <https://docs.soliditylang.org/en/latest/introduction-to-smart-contracts/>



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COMPUTER VISION			
Semester	III	CIE Marks	50
Course Code	24MCPE663	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03
Course Learning Objectives:			
This course is designed for students to:			
<ol style="list-style-type: none"> 1. Impart knowledge on the fundamental concepts of image processing. 2. Familiarize with different techniques while enhancing images. 3. Provide knowledge on image segmentation and compression algorithms for image processing. 4. Impart the principles of image formation, image processing algorithms and different algorithms for recognition from single or multiple images. 5. Disseminate the core vision tasks of scene understanding and recognition in real world scenarios. 			
Module 1 : Introduction to Computer Vision			No. of Hrs: 06+04
Introduction to Computer vision, Image formation: Geometric primitives and transformations: Geometric primitives, 2D, 3D transformation, 3D rotation, 3D to 2D projections, Lens distortions, Photometric image formation: Lighting, Reflectance and shading, Optics. The digital camera: Sampling and aliasing, Color, Compression.			
Text Book 1 – Ch 1, 2			
Laboratory component			
<ol style="list-style-type: none"> 1. Implement basic image transformations and perform perspective correction using a real-world image. 			
Tasks:			
<ol style="list-style-type: none"> a. Load an image (e.g., a photograph of a document taken at an angle). b. Apply basic transformations such as scaling, rotation, and translation to the image. c. Use the concept of Perspective Transformation to correct the skew in the document image and obtain a properly aligned, front-facing version of the document. d. Visualize the original and transformed images. 			
<ol style="list-style-type: none"> 2. Apply different convolution masks (kernels) to an image to observe the effects of smoothing, sharpening, and edge detection. 			
Tasks:			
<ol style="list-style-type: none"> a. Load an image. b. Apply the following convolution masks to the image: <ol style="list-style-type: none"> i. Smoothing (blurring): Use a Gaussian kernel. ii. Sharpening: Apply a high-pass filter (e.g., Laplacian mask). iii. Edge Detection: Use the Sobel or Prewitt operators to detect edges in both horizontal and vertical directions. 			
Module 2: Image processing			No. of Hrs: 05+04

Point operators: Pixel transforms, Color transforms, Compositing and matting, Histogram equalization. Linear filtering: Separable filtering, Examples of linear filtering, Band-pass and steerable filters. More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization.

Text Book 1 – Ch 3

Laboratory component

3. Write a program to perform the following tasks:
 - a. Load a grayscale image and introduce synthetic noise (e.g., Gaussian noise or Salt-and-Pepper noise) to simulate a noisy image.
 - b. Display the original and noisy images side by side.
 - c. Implement spatial filtering techniques to reduce the noise:
 - Apply a filter to the noisy image.
 - d. Display the filtered images alongside the original and noisy images for comparison.

Module 3: Feature Extraction and Image Segmentation

No. of Hrs: 05+06

Points and patches: Feature detectors, Feature descriptors, Feature matching, Feature tracking.

Edges: Edge detection, Edge linking, Lines: Successive approximation, Hough transforms, Vanishing points.

Text Book 1 – Ch 4, 5

Laboratory component

4. Implement one or more descriptors and compare their performance.
5. Implement a Hough transform for finding lines in images.
6. Compute the vanishing points in an image using one of the techniques.

Module 4 : Structure and Motion Analysis

No. of Hrs: 05+04

Triangulation: Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion.

Dense motion estimation: Translational alignment, Parametric motion, Spline-based motion, Layered motion.

Text Book 1 – Ch 7, 8

Laboratory component

7. Write a program to segment an image into separately moving regions or to reliably find motion boundaries.
8. Decompose into separate layers a video sequence of a scene taken with a moving camera.

Module 5: Recognition

No. of Hrs: 05+06

Object detection: Face detection, Pedestrian detection, Face recognition: Eigenfaces, Active appearance and 3D shape models, Instance recognition: Geometric alignment, Large databases.

Category recognition: Bag of words, Part-based models, Recognition with segmentation, Context and scene understanding, Recognition databases and test sets: Learning and large image collections.

Text Book 1 – Ch 9

Laboratory component

9. Build and test one of the face detectors.
 - a. Download one or more of the labeled face detection databases
 - b. Generate your own negative examples by finding photographs that do not contain any people.
 - c. Implement face detectors.
10. For a set of facial photographs build a recognition system to re-recognize a person.
 - a. Take several photos of each of your classmates and store them.
 - b. Align the images by automatically or manually detecting the corners of the eyes and using a similarity transform to stretch and rotate each image to a canonical position.
 - c. Compute the average image and a PCA subspace for the given face images
 - d. Take a new set of photographs a week later and use them as your test set.

Course Outcomes:

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

CO1: Identify the different image acquisition and sampling techniques for image formation and transformation.

CO2: Apply different filtering techniques and image compression methods on given problems.

CO3: Utilize image formation and image processing techniques on image detection.

CO4: Apply matching algorithms for various image modalities to implement robust feature detection.

CO5: Make use of computer vision techniques to develop real-world applications across several domains.

Textbooks:

1. Richard Szeliski, “*Computer Vision: Algorithms and Applications*”, 2nd Edition, Springer, 2020

Reference Books:

1. D. Forsyth and J. Ponce, “*Computer Vision – A modern approach*”, 2nd Edition, Prentice Hall, 2012
2. S. Sridhar, “*Digital Image Processing*”, 2nd Edition, Oxford University Press, 2016
3. D. H. Ballard, C. M. Brown. “*Computer Vision*”. Prentice-Hall, Englewood Cliffs, 1982
4. S. Jayaraman, S. Esakkirajan, T. Veerakumar, “*Digital Image Processing*”, Tata McGraw Hill 2014

Web Links:

1. Computer Vision: <https://www.youtube.com/watch?v=WHgbp6dsk2M>
2. Computer Vision with Tensorflow and Keras:
<https://www.kaggle.com/learn/computer-vision>
3. Object detection: <https://www.youtube.com/watch?v=WgPbbWmnXJ8>

APPLICATIONS OF MACHINE LEARNING FOR IMAGE AND VIDEO ANALYTICS

Semester	III	CIE Marks	50
Course Code	24MCPE664	SEE Marks	50
Teaching Hrs/Week (L:T:P)	2:0:2	Exam Hrs	03
Total Hrs	50 (26 Theory + 24 Lab)	Credits	03

Course Learning Objectives:

This course is designed to:

1. Impart the fundamental knowledge on image processing.
2. Instill skills to perform image enhancement and apply filters related to special and frequency domain.
3. Provide knowledge on image segmentation for image analysis.
4. Familiarize students with the general architecture of a face recognition system.
5. Impart the knowledge on video segmentation and shot detection techniques.

Module 1: Fundamentals of Image processing

No. of Hrs: 06 + 04

Introduction – Steps in image processing systems – Image acquisition -Sampling and Quantization – Pixel relationships – Color fundamentals and models, File formats, Image operations – Arithmetic and Morphological.

Textbook 1 – Ch 1, 2

Laboratory components

1. Implement a program to load a grayscale image and apply different levels of quantization (e.g., 2-bit, 4-bit, 8-bit). Display the original image alongside the quantized versions to observe the effect of reduced bit depth on image quality.
2. Implement a program to demonstrate different interpolation techniques that affect image quality, especially along edges, when rotating an image.

Module 2: Image Enhancement

No. of Hrs: 05 + 04

Spatial Domain: Gray level Transformations – Histogram processing – Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – DFT, FFT, DCT – Smoothing and sharpening filters – Homomorphic Filtering.

Textbook 1 – Ch 3, 4, 8

Laboratory components

4. Implement a program to load a grayscale image and perform gray level transformations, including contrast stretching, negative transformation, and gamma correction. Display the original and transformed images along with their histograms.
5. Load a grayscale image and convert it to the frequency domain using the Discrete Fourier Transform (DFT). Implement low-pass and high-pass filters in the frequency domain and apply them to observe the effects of frequency-based smoothing and sharpening.

Module 3: Image Segmentation and Feature Analysis

No. of Hrs: 05 + 04

Detection of Discontinuities – Edge operators – Edge linking and Boundary Detection – Thresholding – Region based segmentation – Morphological Watersheds – Motion Segmentation.

Textbook 1 – Ch 9, 10

Laboratory components

5. Implement a program to segment an image using thresholding methods. Then, apply region-based segmentation techniques, to extract distinct regions in the image.

6. Use morphological operations to preprocess a video sequence and apply the watershed algorithm to segment moving objects.

Module 4: Image Analysis

No. of Hrs: 05 + 06

Introduction, Image Recognition: General Approach, Image Detection and Localization: Image Segmentation and Normalization with TorchVision, Lighting Normalization: Center/Surround Retinex, Gross and Brajovic's Algorithm, Normalization with TorchVision, Feature Extraction: Holistic Approaches, Local Approaches, Feature Extraction with TorchVision, Classification, Performance Assessment.

Textbook 2 – Ch 13

Laboratory components

7. Implement face detection and localization using pre-trained models available in TorchVision.
8. Extract features from facial images using holistic and local approaches with TorchVision.
9. Classify faces using extracted features and evaluate the classification performance.

Module 5: Video Analysis

No. of Hrs: 05 + 06

Introduction, Applications of Video Segmentation, Shot Boundary Detection: Pixel-Based Approaches, Block-Based Approaches, Histogram-Based Approaches, Clustering-Based Approaches, Performance Measures, Shot Boundary Detection with Torchvision, Keyframe Extraction, Keyframe Extraction with Torchvision and Torch.

Textbook 2 – Ch 14

Laboratory components

10. Implement shot boundary detection using pixel-based approaches and block-based approaches for a given video.
11. Develop a program to extract keyframes from a video using histogram-based approaches.
12. Apply Torch and Torchvision to extract keyframes based on clustering-based approaches.

Course Outcomes:

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

CO1: Outline the fundamentals of image processing.

CO2: Apply gray-level transformations and implement special and frequency domain filtering.

CO3: Make use of various approaches to achieve improvement in segmentation performance.

CO4: Apply different types of face recognition mechanisms to solve real-world problems.

CO5: Utilize various video segmentation techniques, and assess their performance.

Textbooks:

1. Rafael C. Gonzalez and Richard E. Woods, “*Digital Image Processing*”, 3rd Edition, Pearson Education, 2009
2. Francesco Camastra, Alessandro Vinciarelli, “*Machine Learning for Audio, Image and Video Analysis*”, SPIN Springer’s internal project number, 2007

Reference Books:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “*Image Processing, Analysis, and Machine Vision*”, 4th Edition, Thomson Learning, 2013
2. Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, “*Video Analytics for Business Intelligence*”, Springer, 2012



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Web Links:

1. Real time analytics for Image and Video: <https://tinyurl.com/mlimagevideo>
2. Real Time Video Analytics: <https://www.youtube.com/watch?v=uSgwTQV45IY>
3. Image recognition: <https://cloud.google.com/vision/>
4. Video data processing: <https://www.youtube.com/watch?v=AxIc-vGaHQ0>



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MAJOR PROJECT PHASE-1

Semester	III	CIE Marks	100
Course Code	24MCSE613	SEE Marks	-
Teaching Hours/Week (L:T:P)	-	Exam Hrs	-
Total Hours	-	Credits	05

Course Learning Objectives:

This course is designed to

1. Learn how to gather pertinent information from different sources and learn to perform a good literature survey.
2. Empower a student's ability to apply concepts, theories, and methodologies from their coursework to solve real-world problems or meet specific project requirements.
3. Impart latest industry requirements and get skilled in those areas to deliver solutions for problems.
4. Enable a student to improve his/her presentation skills and time management skills.
5. Gather the requirements of the project work and present his/her work in a technical seminar and documenting the project work via a project report.

Guidelines

- A student will be allotted a supervisor/guide in the department.
- He/She in consultation with the guide has to carry out a proper literature survey/visit industries to finalize the topic of the major project.
- Developing a Software Requirements Specification (SRS) document.
- Preparation of synopsis
- Seminar Presentation

Course Outcomes:

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

CO1: Use prior art search literature and arrive at the right problem definition.

CO2: Apply disciplined software engineering practices to collect the requirements for the given problem.

CO3: Build sound technical knowledge in his/her selected project topic and domain.

INTERNSHIP

Semester	III	CIE Marks	50
Course Code	24MCSE614	SEE Marks	50
Teaching Hours/Week (L: T:P)	-	Exam Hrs	03
Total Hours	-	Credits	05

Course Learning Objectives:

1. To realize the real-time experience of the software industry.
2. Identify and understand the importance of working as a team in a company.
3. To gain professional skills and learn to work independently towards a variety of projects.
4. Learn and adhere to professional standards in the industry.

Guidelines

- Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship. The duration of the internship will be 10 weeks. This is a mandatory internship that should be completed by a student during the intervening vacation of second and third semester.
- Once the student completes his/her internship, the student is required to present a seminar on the internship to the Internship Coordinator after consultation with the Head of the Department before the internship starts and this information will be disseminated to the students before their internship starts in the industry.
- A report of the internship has to be prepared and submitted during the review seminar.

Course Outcomes :

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

- Apply the knowledge and skills learnt during their internship in their project work.
- Identify the different technical skills required to a variety of project requirements from time to time.
- Identify the different areas that can be explored depending on one's interest and skill levels.
- Develop a better understanding on the career options available in the industry today.



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IV SEM



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MAJOR PROJECT PHASE - 2			
Semester	IV	CIE Marks	100
Course Code	24MCSE621	SEE Marks	100
Teaching Hrs/Week (L:T:P)	-	Exam Hrs	03
Total Hrs	-	Credits	14

Course Learning Objectives:

This course is designed to

1. Implement the project with the already identified requirements
2. Organize his/her project work in the appropriate manner and present information on the project clearly to all the stakeholders.
3. Ensure that a right solution is obtained as per the requirements of the problem in hand.
4. Enable a student to present his/her project work
5. Present the project work in a technical seminar and document the project work via a project report.

Guidelines

1. A student is expected to carry out the project work in regular consultation with the supervisor/guide to whom he/she was assigned during Major Project Phase-1.
2. Attending Project reviews.
3. Presenting or Publishing the project work in a reputed conference / journal.

Course Outcomes:

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

1. Apply disciplined software engineering principles and practices throughout the development of the project work.
2. Build the software application as specified in the software requirement specification.
3. Choose and acquire the appropriate skills required for a typical project from time to time.
4. Use critical thinking and problem solving skills required for developing a software application.

MOOC COURSE			
Semester	IV	CIE Marks	-
Course Code	24MCSE622	SEE Marks	-
Teaching Hrs/Week (L:T:P)	-	Exam Hrs	-
Total Hrs	-	Credits	02

Guidelines:

- The student should mandatorily complete one NPTEL Course of 8/12 weeks duration during their second year of MCA program.
- He/She should take up the course in their respective stream of interest which they have already opted for during the second semester.
- The student will be informed before they go for their internships.
- The respective stream coordinators will suggest a list of courses to the students.
- The list of courses will get ratified from the Board of Studies (BOS).
- The student has to select a course that has been suggested by the respective stream coordinator from the authorized list.
- He/She will not be allowed to select any other course apart from the BOS recommended list of courses in their particular stream they have opted.
- In addition, if a student wants to complete more than one NPTEL course, or any other MOOC course it is his/her choice.
- This is apart from one mandatory course of 8/12 weeks duration.
- In case the student is not able to clear the NPTEL course in the first attempt, he/she can take up any other NPTEL course of duration 8/12 weeks in his/her stream of interest that will again be suggested by the respective stream coordinators.
- The course list for this will be provided once the NPTEL releases the list of courses from time to time.