PG-R25 Curriculum
with effective from 2025-26

Master of Computer Application

Scheme of Instruction and Syllabi of

MCA I to IV Semester of

Two Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institute | Affiliated to Osmania University)

Accreditated by NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad-500075, Telangana

E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in

Phone No.: 040-24193276/277/279

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
An Autonomous Institute I Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad, Telangana-500075, www.cbit.ac.in
Approved by | Affiliated to | UGC Autonomous | 10 Programs Accredited by | Grade A++ in | All India Ranking 151-200 Band
COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 46 years

Scheme of Instruction and Syllabi

of

I - IV SEMESTERS

of

TWO YEAR POST GRADUATE PROGRAMME

in

MASTER OF COMPUTER APPLICATIONS (MCA)

R-25 Regulation

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DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

The Vision of the MCA Department:

To become a premier center in the field of Computer Applications that produces innovative, skillful and socially responsible professionals who can contribute significantly to academics, research and industry.

The Mission of the MCA Department:

1. Equip students with cutting-edge knowledge and skills in Computer Science and Applications to meet evolving global demands.
2. Foster technical expertise through collaborative learning, research, and innovative practices.
3. Promote lifelong learning, ethical values, social responsibility, and professionalism to address contemporary challenges.

Programme Educational Objectives of the MCA Department:

Graduates will

PEO 1	:	Possess a strong foundation in Computer Science Applications, demonstrating proficiency in programming languages, software development and other core areas
PEO 2	:	Excel in career by exhibiting societal consciousness, creativity and technical competency in emerging areas of computer applications.
PEO 3	:	Demonstrate a commitment to professional and social responsibility while applying computational thinking, adapting to industry demands, and undertaking professional development activities

Programme Outcomes of the MCA Department:

After completion of two year MCA course, the students will be able to:

PO 1	**:**	Apply mathematical foundations and concepts of Computer Science to meet the Industry requirements
PO 2	**:**	Analyze, design and investigate complex problems to formulate solutions using domain knowledge with Emerging tools and technologies
PO 3	**:**	Develop creative applications with acquired skills to become Information Technology professional.
PO 4	**:**	Communicate effectively through oral and written forms and demonstrate strong interpersonal skills in diverse teams.
PO 5	**:**	Recognize societal needs and develop solutions with professional ethics
PO 6	**:**	Acquire the software project management skills, lifelong learning, career enhancement and to adopt in evolving professional environments

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

Scheme of Instructions for I Semester of **MCA (Master of Computer Applications)**

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/S		CIE	SEE	
THEORY								
1	25MCC101	Data Structures Using C++	4	-	3	40	60	4
2	25MCC102	Computer Architecture	4	-	3	40	60	4
3	25MCC103	Object-oriented programming using Java	4	-	3	40	60	4
4	25MTC101	Mathematical Foundation for Computer Science	3/1	-	3	40	60	4
5	25MTC102	Probability and Statistics for Data Science	3/1	-	3	40	60	4
PRACTICALS								
6	25MCC104	Data Structures Using C++ Lab	-	3	3	50	50	1.5
7	25MCC105	Object Oriented Programming using Java Lab	-	3	3	50	50	1.5
8	25EG101	Professional Communication Skills Lab	-	2	3	50	50	1
		TOTAL	**18/2**	**8**	**-**	**350**	**450**	**24**

L: Lecture
P: Practical/Project Seminar/Dissertation

CIE: Continuous Internal Evaluation
SEE: Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

Scheme of Instructions for II Semester of **MCA (Master of Computer Applications)**

SEMESTER-II

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L	P/S		CIE	SEE	
THEORY								
1	25MCC106	Database Management Systems	4	-	3	40	60	4
2	25MCC107	Web Technologies	4	-	3	40	60	4
3	25MCC108	Operating Systems	4	-	3	40	60	4
4	25MCC109	Data Engineering with Python	4	-	3	40	60	4
5	25MCE101/ 25MCE102/ 25MCE103/ 25MCE104	Professional Elective - I	3	-	3	40	60	3
PRACTICALS								
6	25MCC110	Database Management Systems Lab	-	3	3	50	50	1.5
7	25MCC111	Web Technologies Lab	-	3	3	50	50	1.5
8	25MCC112	Operating Systems Lab	-	3	3	50	50	1.5
		TOTAL	**19**	**9**	**-**	**350**	**450**	**23.5**

CIE: Continuous Internal Evaluation

L: Lecture

P: Practical/Project Seminar/Dissertation **SEE: Semester End Examination**

Internship is compulsory after II Semester with 3 credits

Professional Elective - I	
25MCE101	Design and Analysis of Algorithms
25MCE102	Business Analytics
25MCE103	Free and Open Source Technologies
25MCE104	Digital Marketing and E-Commerce

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

Scheme of Instructions for III Semester of **MCA (Master of Computer Applications)**

SEMESTER - III

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Max. Marks		
			L	P/S		CIE	SEE	
THEORY								
1	25MCC113	Artificial Intelligence and Machine Learning	4	-	3	40	60	4
2	25MCC114	Software Engineering and DevOps	4	-	3	40	60	4
3	25MCC115	Computer Networks	4	-	3	40	60	4
4	25MCE105/ 106/107/108	Professional Elective- II	3	-	3	40	60	3
5	25MCE109/ 110/111/112	Professional Elective-III	3	-	3	40	60	3
PRACTICALS								
6	25MCC116	Machine Learning Lab using Python	-	3	3	50	50	1.5
7	25MCC117	Software Engineering Lab	-	3	3	50	50	1.5
8	25MCC118	Mini Project with Seminar	1	3	-	50	-	2.5
9	25MCC119	Internship	-	5 weeks (135 hours)	-	100	-	3
		TOTAL	**19**	**9**	**-**	**450**	**400**	**26.5**

L: Lecture **CIE: Continuous Internal Evaluation**

P: Practical/Project Seminar/Dissertation **SEE: Semester End Examination**

Professional Elective – II	
25MCE105	Cloud Computing
25MCE106	Big Data Analytics
25MCE107	Distributed Application Development
25MCE108	Soft Computing

Professional Elective - III	
25MCE109	Internet of Things
25MCE110	User Interface and User Experience Design
25MCE111	Software Reuse Techniques
25MCE112	Social Network Analysis

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

Scheme of Instructions for IV Semester of **MCA (Master of Computer Applications)**

SEMESTER - IV

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L	P/S		CIE	SEE	
THEORY								
1	25MCE113 / 114 / 115 / 116	Professional Elective – IV	3	-	3	40	60	3
2	25MCE117/ 118 / 119 / 120	Professional Elective – V	3	-	3	40	60	3
3	25MEO201/ 25MBO104/ 25MEO202 / 25CEO102	Open Elective	3	-	3	40	60	3
4	25MCC121	Project Work	-	24	3	100	100	12
TOTAL			**9**	**24**	**-**	**220**	**280**	**21**

L: Lecture **CIE: Continuous Internal Evaluation**

P: Practical/Project Seminar/Dissertation **SEE: Semester End Examination**

Professional Elective – IV	
25MCE113	Cyber Security
25MCE114	Quantum Computing
25MCE115	Block Chain Technology
25MCE116	Natural Language Processing

Professional Elective – V	
25MCE117	High Performance Computing
25MCE118	Software Project Management
25MCE119	Explainable Artificial Intelligence
25MCE120	Deep Learning

Open Elective	
25MEO201	Intellectual Property Rights
25MBO104	Organization Behavior
25MEO005	Research Methodologies and Innovation.
25CEO102	Disaster Control and Response

CREDIT DISTRIBUTION TABLE

S. No	Syllabus Component	No. of Courses	No. of credits	Credits %
1.	Core Theory	10	40	42.10
2.	Core Practical	7	10.5	11.05
3.	Project/Mini Project with Seminar	2	14.5	15.26
4.	Internship	1	3	3.15
5.	Core Electives	5	15	15.80
6.	Open Elective	01	03	3.15
7.	Mathematics	02	08	8.44
8.	English	01	01	1.05
	Total	**29**	**95**	**100%**

Total No. of Courses: 29 **Total No. of Credits: 95**

Plan of Study of I-IV Semesters of MCA (R25 Curriculum)

SNO	I Semester		II Semester		III Semester		IV Semester	
	Course Name	**L-P-C**	**Course Name**	**L-P-C**	**Course Name**	**L-P-C**	**Course Name**	**L-P-C**
1	Data Structures using C++	4-3-5.5	Database Management Systems	4-3-5.5	Artificial Intelligence & Machine Learning	4-3-5.5	Professional Elective – IV	3-0-3
2	Computer Architecture	4-0-4	Web Technologies	4-3-5.5	Software Engineering and DevOps	4-3-5.5	Professional Elective – V	3-0-3
3	Object-oriented programming using Java	4-3-5.5	Operating Systems	4-3-5.5	Computer Networks	4-0-4	Open Elective	3-0-3
4	Probability and statistics for Data Science	4-0-4	Data Engineering with Python	4-0-4	Professional Elective- II	3-0-3	Project Work	0-24-12
5	Mathematical Foundation for Computer Science	4-0-4	Professional Elective-I	3-0-3	Professional Elective –III	3-0-3	--	--
6	Professional Communication Skills Lab	0-2-1			Mini Project	1-3-2.5	--	--
7	--	--	--	--	Internship	0-0-3	--	--
Hours		**28**		**28**		**28**		**21**
Credits		**24**		**23.5**		**26.5**		**21**

25MCC101

DATA STRUCTURES USING C++

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Basic Mathematical Knowledge, Programming for problem solving, Object Oriented Programming.

COURSE OBJECTIVES: This course aims to

1. Learn fundamental concepts of CPP and Object oriented programming
2. Learn linear and non-linear data structures concepts

COURSE OUTCOMES*:* After completion of this course, student will be able to

1. Understand the basic concepts of C++, build classes with functions, constructors and destructors.
2. Apply OOPS concepts like Inheritance, Polymorphism, Virtual Functions wherever required.
3. Make use of various linear data structures and their implementation according to situations.
4. Apply and Distinguish different sorting techniques and their implementation in real world environment. Implement different collision resolution techniques on hashing.
5. Make use of various non-linear data structures and their implementation according to situations

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	2	1
CO2	3	3	3	1	1	1
CO3	2	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	1	1	1	1

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT- I

C++ Introduction: Overview, Program Structure, Tokens, Keywords, Identifiers, Variables, Constants, Data Types, Namespace, Enumerated Data Types, Operators, console I/O Statements, Arrays, Pointers, Parameter Passing Techniques, Overloading of functions, Default Arguments, Inline Functions, Dynamic Memory Allocation and De Allocation (new and delete).

C++ Class Overview: Class Definition, Objects, Class Members, Access Control, Class Scope, Constructors and Destructors.

UNIT- II

OOPS Concepts: Inheritance basics, Base and Derived Classes, Inheritance Types, Base Class Access Controls, Friend Functions, this pointer, Templates, Function and Class Templates, Polymorphism, Function Overriding, Runtime Polymorphism using Virtual Functions, Operator Overloading of Unary and Binary Operators , Exception Handling.

UNIT- III

Stacks: Definition and Operations and Applications, Array and Linked Representation of Stacks. Queues: Definition and Operations, Array and Linked Representation of Queues and their Applications. Linked Lists: Definition and Operations, Double Linked List representation, Circular Linked Lists.

UNIT- IV

Sorting: Bubble Sort, Merge Sort, Selection Sort, heap Sort, Quick Sort, Insertion Sort, Asymptotic Notations, Sequential Search, Binary search.

Hashing: Hash Table and its implementation, Hash Table Representation, Types of Hashing and Collision Resolution Techniques.

UNIT- V

Trees: Definitions and Properties, Representation of Binary Trees, Operations. Binary Tree Traversal, Binary Search Trees, Operations- insertion, deletion and searching, Heap trees. AVL Tress and Operations on AVL Trees, B-Trees and its operations.

Graphs: Definition and Representation of Graphs, Data Structures for representing Graphs- Edge List Structures, Adjacency List Structures, Adjacency Matrix, Graph traversals – BFS and DFS. Spanning Trees, Minimum Spanning Trees.

TEXT BOOKS:

1. E. Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw Hill, 4th Edition, 2008.
2. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++", Universities Press. 2nd Edition, 2008.

SUGGESTED READING:

1. Langsam, Augenstein and Tanenbaum, "Data structures using C and C++", PHI, 2nd Edition, 2002.
2. Dr. B. Indira, Dr. Keshetti Sreekala, Mr. C.N.V.B.R. Sri Gowrinath, Mr. Ramesh Ponnala, "Data Structures and Algorithms using C" 2022, SIPH International Publishers.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Pearson Education. Ltd., 2007.

25MCC102

COMPUTER ARCHITECTURE

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Basic knowledge of Computer components and Digital circuits

COURSE OBJECTIVES: This course aims to

1. Understand the basic operations of Digital logic circuits, register operations, computer instructions
2. Able to assess the role & operations of CPU, I/O organization, memory organization, pipelining & parallel processing

COURSE OUTCOMES: After completion of the course, the students will be able to:

1. Apply the operations and utilities of Boolean algebra and K Maps, flip flops
2. Evaluate the working of Registers and types of Computer instructions
3. Analyze the micro programmed control, addressing modes and data transfer operations.
4. Classify the operations of CPU and their functionality.
5. Assess the input–output, memory organization and concepts of parallel processing.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	1	1	1
CO2	1	2	1	1	1	1
CO3	2	3	3	1	1	1
CO4	2	3	3	1	1	1
CO5	3	3	3	1	1	1

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT -I

Basic operations of Logic Circuits: Fundamentals of Computer components– Memory – I/O devices - Logic Gates, Boolean algebra, 3 and 4 Variable K Maps, Half Adder and Full Adder, flip flops, Multiplexer – Decoder.

UNIT -II

Register Transfer and Micro Operations: Registers, and Shift Registers, Register Transfer language, Arithmetic, logical and Shift Micro operations, Instruction codes, CPU Registers, Common bus system, ALU circuit & operation, Computer Instructions, Memory Reference Instructions, Interrupts

UNIT -III

Central Processing Unit: Micro programmed Control, Control Memory, Address sequencing, General Register Organization, Stack Organization, Instruction Formats, Nine Addressing Modes, Data Transfer operations

UNIT -IV

Input–Output and Memory Organization: Peripheral Devices, I/O output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupts, DMA controller and DMA process, Input output Processor, 3 types of Cache Memory mapping procedures

UNIT -V

Parallel Processing: CISC & RISC architectures, pipe lining, parallel Processing, Parallelism V/S Pipelining, Time – space chart mechanism, Shared Memory Multiprocessing, , Multi Programming and Time Sharing. Assessing and Understanding Performance: CPU performance and its factors, evaluating performance.

TEXT BOOKS:

1. M. Morris Mano, "Computer System Architecture", Pearson Asia/Prentice Hall, Revised 3rd Edn.2017.
2. M.Sasi Kumar, Dinesh Shikhare, P. Ravi Prakash, “Introduction to Parallel Processing”, Published by PHI- 2nd Edition. 2014.

SUGGESTED READING:

1. William Stallings, "Computer Organization & Architecture", Pearson Education, 11th Edition, 2022.
2. Kai Hwang and Faye A.Briggs, “Computer Architecture and Parallel Processing” International Edition.

25MCC103

OBJECT-ORIENTED PROGRAMMING USING JAVA

Instruction	4L Hours per week
Duration of Semester-End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Problem Solving Skills, Basic knowledge of any programming language

COURSE OBJECTIVES*:* This course aims to

1. Learn object oriented programming principles and fundamentals of Core Java.
2. Understand the basic concepts of Collection Framework, Stream API.

COURSE OUTCOMES*:* After completion of this course, student will be able to

1. Make use of conceptual and practical knowledge of basic Object-Oriented Programming concepts.
2. Develop complex Object-Oriented Programs using distinct OOP principles, interfaces, packages
3. Develop exception handling mechanism and multithreading.
4. Apply string functions and latest concept like Lambda Expressions, Annotations.
5. Identify the importance of the Collections framework, Stream API to develop complex applications

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	3	3
CO2	2	3	3	2	3	2
CO3	2	3	3	2	3	2
CO4	2	2	2	1	3	3
CO5	3	3	3	3	3	3

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT -I

Object Oriented Programming**:** Introduction to java, Object Oriented Programming, Data types, Variables and Arrays, Operators, Lexical Issues, Control Statements.

UNIT -II

Introduction to Classes**:** Classes, Methods, Constructors, This keyword, Garbage Collection, Overloading, Recursion, nested classes, inner classes,

Inheritance**:** Inheritance and its types, super, Overriding, Dynamic method dispatch, Abstract Classes, Using final.

Packages and Interfaces: packages, Access protection, importing packages, Interfaces.

UNIT -III

Exceptional Handling**:** Exception–handling fundamentals, Exception types, Using try and Catch, throw, throws, and finally clauses.

Multithreaded Programming**:** Java Thread Model, Creating Threads, Suspending, Resuming, and Stopping Threads, T hread Priorities, Synchronizing Threads, Inter-thread Communication.

UNIT – IV

String Handling**:** String class, String buffer class, String length, Special String operations, string

comparison, modifying a string, string builder,Enumerations, Primitive type wrappers and Auto boxing, Overview of Annotations

Lambda Expressions: Introducing Lambda Expressions, Passing Lambda Expressions as Arguments, Method References, and Constructor References
Java I/O: Classes and Interfaces, File class, Stream and Byte Classes, Reading and Writing Files.

UNIT –V

The Collections Framework: overview of Collections framework, The Collection interfaces-Collection Interface, List Interface, Set Interface, Sorted Set Interface, Navigable Set Interface , Queue Interface, Deque Interface Collection classes – Array List, Linked List, Hash Set, Linked Hash Set, Tree Set, and Priority Queue, Accessing Collections via Iterator, working with Maps, Comparator, Comparable Vs Comparator
Stream API**:** Stream Basics, Stream Interfaces, Reduction Operations, Using Parallel Streams, Mapping, Collecting, Iterators and Streams

TEXT BOOKS:

1. Herbert Schildt "Java, The Complete Reference" McGraw Hill Education, JavaTM 10th Edition 2018.
2. R. Nageshwar Rao, "Core Java: An Integrated Approach, New: Includes All Versions Upto Java 8",DreamTech Press, 2016
3. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India Edition 2009.

SUGGESTED READINGS:

1. John Dean and Raymond "Introduction Programming with Java A problem-solving approach", McGraw Hill 2008.
2. G.N.R Prasad and Premchand. P, "OOP through JAVA" National Publishing House 2010 New Delhi.
3. Joe Wigglesworth and Paula McMillan, "Java Programming: Advanced Topics" Cengage Learning. 3rd Edition 2009.

25MTC101

MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE

Instruction	3L + 1T hrs per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites:- Analytical thinking and logical reasoning, Permutations and Combinations, Algebraic Structures.

COURSE OBJECTIVES: This course aims
1. To Understand logical Connectives, implications and inference rules.
2. To use Hasse diagrams to visualize the data and to learn Graph Theory Applications.

COURSE OUTCOMES: After completion of the course the students will be able to:
1. Understand the required propositional logic to test the logic of a program.
2. Examine various properties of Relations and Functions.
3. Identify the basics of Linear Algebra in the form of Matrices and Vectors.
4. Expose the principle of Inclusion and Exclusion as a basis for various Permutations and Combinations.
5. Impart the procedural knowledge on Graphs and Trees to derive applications in Computer science.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	1
CO2	3	2	1	-	-	-
CO3	3	1	2	-	-	1
CO4	3	2	1	-	-	-
CO5	3	1	2	-	-	1

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT – I
Fundamentals of Logic: Basic Connectives and Truth Tables, Logical Equivalence, Logical Implication, Use of Quantifiers, Definitions and the Proof of Theorems. Boolean algebra: Switching functions, Disjunctive and Conjunctive Normal forms, Gating Networks, Minimal sum of Products.

UNIT – II
Functions: Cartesian product, Functions, Onto Functions, Special Functions, Pigeonhole Principle, Composition and Inverse Functions. Relations: Partial Order Relations, Hasse diagrams, Lattices, Equivalence Relations.
Introduction to Gradient Descendent Algorithm and its applications.

UNIT – III
Linear Algebra: Linear Algebraic Systems- Matrices and Vectors, Matrix Inverses, Transposes and Symmetric Matrices. Vector Spaces: Real Vector Spaces and Sub spaces, Span and Linear Independence, Basis and Dimension of Vector Space, Eigen values and Eigen Vectors and its real-world applications.

UNIT – IV
Principles of Inclusion and Exclusion: Introduction, Generalization of principle, Derangements, Rooks Polynomial, Arrangements with Forbidden Positions. Recurrence Relations: First and second order

linear Recurrence relations.

UNIT – V

Graph Theory: Definitions and examples, Sub graphs, Vertex degree, Complements and graph isomorphism. Trees: Definitions, Properties and examples, Rooted Trees, Spanning Trees and Minimum Spanning Trees, Shortest path problems using DFS, BFS , Planar graphs, Eulerian and Hamiltonian paths and Cycles, Graph coloring.

TEXT BOOKS:

1. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, Pearson Education, 4th Edition,2003.
2. Peter J. Olver, ChehrzadShakiban, “Applied Linear Algebra”, Springer International Publishing, 2nd Edition, 2018.

SUGGESTED READING:

1. Kenneth H Rosen, “Discrete Mathematics and its Applications” Tata McGraw Hill, 6th Edition, 2007.
2. J.P Tremblay & R. Manohar, “Discrete Mathematical Structures with Applications to computer science” McGraw Hill. 1987.
3. Joe L. Mott, A.kandal& T.P. Baker, “Discrete Mathematics for Compute Scientists & Mathematicians", Prentice Hall N.J., 1986
4. Kevin Ferland, “Discrete Mathematics”, Houghton Mifflin Company, 2009

25MTC102

PROBABILITY AND STATISTICS FOR DATA SCIENCE

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites:- Basic calculus, Set Theory and Combinations.

COURSE OBJECTIVES: This course aims

1. To provide the fundamental concepts of basic statistics, random variables, and probability distributions for analyzing the data.
2. To formulate the statistical hypothesis for solving real world problems.

COURSE OUTCOMES: Upon completing this course, students will be able to**:**

1. Calculate the measures of skewness.
2. Apply probability on continuous and discrete random variables.
3. Use the basic probability for fitting the Random phenomenon.
4. Apply various tests for testing the significance of sample data.
5. Use the principle of Least Squares approximation for estimation of the data.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	-
CO2	3	2	1	-	1	-
CO3	3	2	1	-	1	-
CO4	3	2	1	-	1	-
CO5	3	2	1	-	1	-

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT-I: Basic statistics

Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Quartile deviation, Standard deviation, Coefficient of dispersion, Coefficient of variation. Skewness: Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness and Kurtosis. Moments about a point and Moments about the Mean.

UNIT-II: Probability and Mathematical Expectation

Probability, Addition Theorem of probability, Conditional Probability, Multiplication theorem of probability, Bayes Theorem, Random variable, discrete random variable, continuous random variable, Properties of probability mass function and probability density function. Mathematical expectation, properties of expectation, properties of variance and covariance. Discrete probability distribution: Poisson distribution, Mean, Variance, MGF, CGF, fitting of Poisson distribution.

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UNIT-III: Probability Distributions

Continuous probability distributions: Normal distribution, Standard Normal random variable Expectation, Variance, MGF (without proof), CGF, Properties of Normal Curve and Areas under Normal curve. Exponential distribution, Expectation, Variance, MGF, CGF, Uniform Distribution, Expectation, Variance, MGF& CGF.

UNIT-IV: Testing of Hypotheses

Test of significance, Null and alternative hypotheses, Errors in sampling, level of significance. Large sample test: Test of significance for single proportion, difference of proportions, single mean and difference of means. T-Test for single mean, differences of Means. F- test for equality of two

population variances. Chi-Square test of Goodness of fit. Analysis of Variance, One way classification, Two way classification and their applications for data science.

UNIT-V: Regression and Curve fitting.

Correlation: Karl Pearson's coefficient of correlation. Linear Regression: Lines of regression, properties of regression coefficients. Curvilinear regression: Fitting of Parabola, fitting of a power curve, Fitting of Exponential curve, fitting of the data for real-world problems.

TEXTBOOKS:

1. S.C.Gupta, V.K.Kappoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Murray R Spiegel, John J Schiller, R Alu Srinivasan, " Probability and Statistics", 3rd Edition,Tata McGraw Hill Education Private Ltd, 2012
3. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.

SUGGESTED READING:

1. Walpole, H.Myers, L.Myers, Ye, " Probability and statistics for engineers & Scientists" 9th edition, Pearson publications, 2016.
2. S.C.Gupta, "Fundamentals of Statistics", Himalaya publishing, 7th Edition ,2014.

25MCC104

DATA STRUCTURES USING C++ LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Basic Mathematical Knowledge, Programming for problem solving, Object Oriented Programming.

COURSE OBJECTIVES*:* This course aims to

1. Learn and do programs on fundamental concepts of CPP and Object oriented programming
2. Learn and do programs on linear and non-linear data structures concepts

COURSE OUTCOMES: After completion of this course, student will be able to

1. Build Programs on basic concepts of C++, Classes with member functions, Constructors and Destructors.
2. Analyze the different Templates and various kinds of Inheritance types and its functionalities.
3. Make use of various Linear Data structures concepts in real world environment.
4. Apply and distinguish different Sorting Techniques and their requirement according to the situations. Implement Collision Resolution Technique of hashing.
5. Distinguish the DFS and BFS of graph traversals and their implementations.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	2	1
CO2	3	3	3	1	1	1
CO3	2	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	1	1	1	1

1 - Slightly, 2 - Moderately, 3 – Substantially

List of C++Programs:

1. Build C++ Programs on Arrays.
2. Build C++ Programs for Call by Value and Call by Reference.
3. Build a C++ program for Inline functions.
4. Build C++ programs for Overloading of Functions, Default Arguments.
5. Write a C++ program for Dynamic Memory allocation and De allocation.
6. Illustrate the concept of Class with member functions, Constructors and destructors.
7. Illustrate the concept of Templates with suitable Programs.
8. Illustrate the concept of Inheritance and its types with suitable programs.
9. Implement Stack using Arrays and Linked Lists
10. Write a C++ programs for implementing Queues using Arrays and Linked Lists
11. Implement Linked Lists using Single, double and Circular Linked Lists and its Applications.
12. Write a C++ program for infix to postfix conversion.
13. Implement Quick Sort.
14. Implement Insertion Sort.
15. Implement Selection Sort.
16. Implement Merge Sort.
17. Implement Heap Sort.

18. Implement Linear Searching.
19. Implement Binary Searching
20. Implement Hashing.
21. Implement Graph Traversals DFS and BFS.

SUGGESTED READING:

1. Herbert Schildt, "Complete reference to C++", 5th Edition, 2015.
2. E. Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw Hill, 4th Edition, 2008.
3. Varsha H. Patil, "Data Structures using C++", OXFORD Higher Education, 2012.

25MCC105

OBJECT-ORIENTED PROGRAMMING USING JAVA LAB

Instruction	3 Hours per week
Duration of Semester-End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Problem Solving Skills, Basic knowledge of programming languages

COURSE OBJECTIVES: This course aims to
1. Learn the concept of classes, Inheritance, and abstract classes
2. Demonstrate real-world applications using Java Collection Framework and Stream API.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Demonstrate and model various mathematical computation programs using OOP concepts.
2. Identify the restrictions on class members using package-level access protection.
3. Apply the forecasting of multiple clients' task execution using Multithreading and exception-handling
Concepts.
4. Analyze the input as well as output data for String and Stream programming.
5. Identify the usage of Collections framework, Lambda Expressions, and Stream API

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	2	3	3	2	2	2
CO3	2	2	2	2	3	3
CO4	2	2	3	3	3	3
CO5	3	3	3	2	3	3

1 - Slightly, 2 - Moderately, 3 – Substantially

List of Java Programs

1. Demonstrate the usage of Operators, Control Structures, Arrays, etc.
2. Create classes, objects, nested classes, inner classes, abstract class,
3. Demonstrate the usage of constructors
4. Implement Method overloading
5. Implement Method overriding, dynamic method dispatch
6. Demonstrate the concept of Inheritance, types of inheritance
7. Implement Interfaces
8. Create and import Packages
9. Implement Exception handling
10. Create multiple threads, synchronization, thread priorities
11. Demonstrate String and String Buffer classes, string Builder
12. Demonstrate Wrapper classes, Enumerations, Auto boxing
13. Create I/O streams and files

14. Demonstrate Collections, Lambda Expressions, Annotations

15. Implement Stream API

Suggested Reading:

1. Herbert Schildt "Java, The Complete Reference" McGraw Hill Education, JavaTM 10th Edition 2018.

2. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India Edition 2009.

25EG101

PROFESSIONAL COMMUNICATION SKILLS LAB

Instruction	2 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic interpersonal and communication skills

COURSE OBJECTIVES: This course aims to:

1. Create awareness about the significance and types of soft skills in formal settings.
2. Develop writing skills for professional communication viz., writing cover letter, Résumé, e-mail, minutes of the meeting, memos and SoP.
3. Analyze their presentation and public speaking skills.
4. Demonstrate their ability to discuss in groups and resolve issues.
5. Understand the process and techniques of attending an interview positively.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Differentiate various soft skills and build an impressive personality.
2. Draft cover letter, Résumé, e-mail, minutes of the meeting, memos and SoP effectively.
3. Deliver effective presentations in professional contexts confidently.
4. Participate in Group discussions and resolve issues proficiently.
5. Face interviews successfully.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	2
CO2	1	1	1	1	1	3
CO3	1	1	1	2	2	3
CO4	1	1	1	3	3	3
CO5	1	1	1	2	1	3

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT - I

Behavioral Skills: Introduction to Various Forms of Soft Skills – Hard Skills vs Soft Skills, Self-Awareness and SWOT Analysis –Techniques of Personality Development – Corporate Culture - Intercultural Communication, Grooming and Professional Etiquette.

UNIT - II

Writing Skills: Cover Letter and Résumé Writing – Structure, Planning and Presentation: Thinking Skills, Defining the Career Objective, Projecting Ones Strengths and Skill-sets–Email Writing– Mechanics of Professional Meetings – Preparation of Agenda, Participation, Writing Minutes of a Meeting and Memorandum –Writing an Effective Statement of Purpose (SOP).

UNIT - III

Presentation Skills: Elements of Effective Presentation – Structure of a Presentation, Presentation Tools, Self-confidence and Assertiveness, Body Language, Eye-contact, Visual Aids, Preparing an Effective PPT**,** Time Management–Public Speaking - Conversational Skills, Oral Review based on TV/Radio/TED Talks/Podcasts/YouTube Videos.

UNIT - IV

Group Discussion: GD as Part of Selection Procedure and its Dynamics, Intervention, Summarizing, Modulation of Voice, Relevance of Body Language, Fluency, and Coherence – Advanced Group

Discussion with Case Studies, Team Building & People Management, Decision Making and Problem Solving and Leadership Skills.

UNIT - V

Interview Skills: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Stress Management & Conflict Resolution– Mock Interviews. LinkedIn Profile Building.

Text Books:

1. Sen, Leena, "Communication Skills", Prentice-Hall of India, New Delhi, 2005.
2. Verma, Shalini. "Body Language - Your Success Mantra", S Chand & Company, New Delhi, 2006.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills: Attitude, Communication and Etiquette for Success", Pearson, New Delhi, 2010.
4. Gulati and Sarvesh, "Corporate Soft Skills", Rupa and Co., New Delhi, 2006.

Suggested Reading:

1. Thorpe, Edgar. and Showick Thorpe, "Objective English", 2nd edition, Pearson Education, 2007.
2. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", Palgrave Macmillan, New York, 2004.
3. Covey, Stephen R. "The 7 Habits of Highly Effective People", Free Press, New York, 1989.

25MCC106

DATABASE MANAGEMENT SYSTEMS

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Discrete mathematics of computer science, Programming skills

COURSE OBJECTIVES*:* This course aims to

1. Learn the basic fundamentals of database, data models, SQL and relational database design.
2. Gain Knowledge in transaction processing, concurrency control techniques, crash and recovery management, NoSQL and security of distributed databases.

COURSE OUTCOMES*:* After completion of this course, student will be able to

1. Make use of basic concepts of the database.
2. Create the data models. Map ER models into Relations and. Common Table Expressions (CTE), and Window Functions
3. Demonstrate query evaluation, normalize the relations, data storage accessing , introductory concepts of NoSQL
4. Illustrate concurrent execution and transaction management.
5. Analyze the issues of system crash, recovery measure and Security in distributed systems relevant to modern data management.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	3
CO2	2	3	3	1	2	3
CO3	2	3	3	1	1	2
CO4	3	3	2	1	2	1
CO5	3	2	3	1	2	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT-I

Introduction to DBMS and DB Models: File system Vs. DBMS, Advantages of DBMS, Data Abstraction, Database Design, and ER diagrams, Entities, Attributes and Entity Sets, Relationship Sets, Additional features of ER model, Conceptual Design with the ER model. The Relational Model: Introduction to the Relational Model, Integrity Constraints over relations,

UNIT-II

Introduction to SQL, creating tables, views, destroying / Altering Tables and Views, Set Operations, Null Values, Additional Basic Operations, Aggregate Functions, Nested Sub queries, Join Expression. Advanced SQL: SQL Data Types, Integrity Constraints, Cursors, Procedures, functions Authorization and Triggers. Common Table Expressions (CTE), and Window Functions.

UNIT-III

JSON data representation and basic query model in document-based NoSQL systems (e.g., MongoDB)., Functional Dependencies, Normal Forms, Basic Concepts of File Organization, Indexing, Index Data Structures, B+ Trees: A dynamic index structure, format of a node, search, Insert, Delete. Hash-Based Indexing: Static Hashing, Extendable Hashing, Linear Hashing, Extendable Hashing

versus Linear Hashing.

UNIT-IV

Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control. Concurrency Control: 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlock, Specialized Locking Techniques, Concurrency Control without Locking.

UNIT-V

Crash Recovery: Introduction to ARIES, The Log, Other Recovery Related Structures, The WAL, Check pointing, recovering from a system Crash, Media recovery. Security and Authorization: Introduction to database security, Access Control Discretionary Access control, Mandatory access control. Additional Issues related to Security. Overview of security challenges in cloud-based and distributed databases.

Text Book:

1. Silberschatz, Korth, Sudarshan, “Database System Concepts”, 7th Edition, McGraw Hill, 2020

Suggested Reading:

1. Raghu Ramakrishna, Johannes, Gehrke "Database Management Systems", 3rd Edition, Mc-Graw Hill 2003
2. Ramez Elmasri, Shamkant B. Navathe, Somayajulu, Gupta "Fundamentals of Database Systems", Pearson Education 2006.

25MCC107

WEB TECHNOLOGIES

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Knowledge of programming fundamentals and web basics

COURSE OBJECTIVES: This course aims to

1. Build client-side web applications using HTML5, Java Script and XML.
2. Develop web applications using React JS

COURSE OUTCOMES: After completion of this course, student will be able to

1. Develop web pages using HTML 5.
2. Apply CSS concepts to present the document in an effective way
3. Examine client-side validations and create interactive web pages using JavaScript.
4. Create XML documents.
5. Build an application using React JS

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	3	3
CO2	2	2	3	2	3	3
CO3	2	2	3	2	3	3
CO4	2	2	3	2	2	2
CO5	2	2	3	2	3	3

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT – I

HTML5: Introduction to web technologies, Exploring new features of HTML5, Fundamentals of HTML: Understanding Elements, Describing Data Types, Working with text: formatting tags, Organizing text in HTML: DIV and SPAN tags, Working with Links and URL: Exploring Hyperlinks and URL, Creating Tables: CAPTION,COLGROUP, COL,TR,TD,TH, Working with images, colors and canvas, Working with forms: types of input: password, text, date time, hidden, check box, radio, submit, reset, TEXTAREA, LABEL,FEILDSET, OUTPUT, submitting form Working with multimedia

UNIT – II

JavaScript: overview of JavaScript: Features, Programming fundamentals, Functions, Events, image maps and animation, Java Script Objects: properties and methods of object, built-in objects Working with Browser objects: Window object, Navigator Object, History Object, Screen object, Location object Working with Document Object: Describing Document Object, Exploring Cookies

UNIT-III

Java Script advanced concepts: Document Object Model: DOM Node, DOM Levels, DOM Interfaces Validation, Errors, Debugging, Exception handling and Security: Form Validation, Errors, Debugging, Handling Exceptions, Security Cascading Style Sheets (CSS): Overview of CSS: Evolution, Syntax, CSS Selectors, inserting CSS in HTML Document Backgrounds, and color Gradients, Fonts and Text styles, Creating Boxes and columns , Displaying , positioning and Floating

an element, Pseudo-classes and Pseudo-Elements, Effects, frames and controls

UNIT –IV

XML: Working with Basics of XML, Implementing Advanced features of XML, Converting XML documents in other formats.

React JS: Fundamentals of react: Requirements, setting up react project, Meet the React component, React JSX, Lists, Components, React DOM, Handler Function in JSX, props, state, Call back Handlers in JSX, React Side Effects

UNIT-V

React JS : Hooks , Custom Hooks, React Fragments**,** Reusable React components**,** Imperative React**,** Inline Handler**,** Asynchronous Data, Data Fetching & Re-Fetching with React, Memorized Handler, Async/Await, Forms in React, class component, CSS ,Styled components in React, SVG'**s**

Text Books:

1. "HTML 5 Black Book", DT Editorial Services, DreamTech Press, 2019
2. Robin Wieruch, "The Road to React: Your journey to master plain yet pragmatic React" , 2020.

Suggested Reading:

1. Thomas Powell "HTML & XHTML: The Complete Reference", 4th Edition, Tata McGraw-Hill, 2003.
2. Thomas A Powell, Fritz Schneider "JavaScript: The Complete Reference", 3rd Edition, Tata McGraw Hill, 2013.

25MCC108

OPERATING SYSTEMS

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Computer Architecture and Programming Fundamentals

COURSE OBJECTIVES*:* This course aims to

1. Learn fundamentals of Operating system concepts system calls, processes, threads and process scheduling.
2. Learn the concepts of process synchronization, dead locks, memory management, file systems, I/O sub system, System Protection.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand the fundamental components of a computer operating system and the interactions among them, Process Management, Threads concept.
2. Analyze the CPU scheduling algorithms, Build applications using Semaphores and Monitors to synchronize their operations.
3. Illustrate the deadlock handling methods, Memory management Techniques, analyze the performance of CPU scheduling and page replacement algorithms.
4. Implement File System concepts, analyze the disk scheduling algorithms and RAID Levels.
5. Illustrate the I/O Sub System Concepts, analyze the System Security and System Protection.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	1
CO2	2	2	2	1	1	1
CO3	2	2	2	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	2	1	1	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT-I

Operating System Introduction: Operating Systems Objectives and functions, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems, Computer System Architecture, OS Structure, OS Operations, Storage management.

System structures: Operating System Services, System Calls, Types of System Calls.

Process Concept: Process Concept, Process Scheduling, Operations on process, Inter process Communication.

Multithreaded Programming: Thread Definition, Single Thread, Multi threads, Multithreading Models.

UNIT–II

Process Scheduling: Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling. Process Synchronization: Critical Section Problem, Peterson's Solution, Semaphores, Classic Problems of Synchronization, Monitors.

UNIT- III

Deadlocks: System Model, Deadlock Characterization, Methods in Handling Deadlocks, Deadlock

Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Paging with Segmentation. Virtual Memory Management: Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT- IV

File System: File Concept, Access Methods, Directory and Disk Structure, File Sharing, Protection. Implementing File System: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free Space Management.

Secondary Storage Structure: Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Swap Space Management, RAID Structure.

UNIT- V

I/O Systems: I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, STREAMS.

System Security: The Security Problem, Program Threats, Cryptography, System and Network Threats, User Authentication, Implementing Security Defenses.

System Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix.

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons, 2018.

Suggested Reading:

1. William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Pearson Education, 2017.
2. Harvey M. Deital, "Operating Systems", 3rd Edition, Pearson Education, 2004.

25MCC109

DATA ENGINEERING WITH PYTHON

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Basic computer skills, including data entry and file management.

COURSE OBJECTIVES: This course aims to

1. Build a strong foundation in data engineering concepts, tools, and databases (Relational & NoSQL) while learning to design basic data pipelines for data acquisition, processing, and storage.
2. Develop Python skills for data handling, including structures, file operations, manipulation, and visualization.

COURSE OUTCOMES: After successful completion of this course, the student will be able to:

1. Analyze the concepts of data engineering, its tools, and its relation to data science.
2. Apply Python programming fundamentals, including control structures, data structures, and string handling, for solving data-related problems.
3. Implement file handling techniques in Python to store, retrieve, and manage different types of data formats.
4. Use Pandas and data visualization libraries to manipulate, analyze, and visualize datasets effectively.
5. Integrate Python with relational and NoSQL databases to insert, extract, and process data for end-to-end data pipelines.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2	1	1	1
CO2	1	2	3	1	1	1
CO3	1	2	3	1	1	1
CO4	2	2	3	1	1	1
CO5	2	3	3	1	3	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT - I

Data Engineering : Data engineers, Required skills and knowledge to be a data engineer, Data engineering versus data science, Data engineering tools, Programming languages , Databases, Data processing engines, Data pipelines. Introduction to Data Science: Data Analysis Sequence, Data Acquisition Pipeline, Report Structure

UNIT - II

Python: Introduction, Control Structures, Boolean Expressions (Conditions), Selection Control, Iterative Control, Lists: List Structures, Lists (Sequences) in Python, and Dictionary Type in Python. And String handling.

UNIT - III

Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python OS and OS.path Modules.

UNIT – IV

Working with Data Series and Frames: Pandas Data Structures, Reshaping Data, Handling Missing Data, Combining Data, Ordering and Describing Data, Transforming Data, Taming Pandas File I/O. Plotting: Basic Plotting with PyPlot, Getting to Know Other Plot Types, Mastering Embellishments, Plotting with Pandas.

UNIT - V

Working with Databases Inserting and extracting relational data in Python: Purpose of relational databases in data engineering, Common relational database systems: MySQL, PostgreSQL, SQLite, Oracle, Understanding Python database connectivity (DB-API). Inserting data into PostgreSQL, Inserting and extracting NoSQL database data in Python Extracting data from databases, running the data pipeline.

Text Books:

1. Data Engineering with Python by Paul Crickard, Packt Publications, 2020
2. Learning Python, 5th Edition by Mark Lutz Oreilly Publications, 2013

Suggested Reading:

1. Fundamentals of Data Engineering: Plan and Build Robust Data Systems by Joe Reis, Matt Housley, Oreilly Publications, 2022
2. Data Engineering for Machine Learning Pipelines: From Python Libraries to ML Pipelines and Cloud Platforms by Pavan Kumar Narayanan, Apress publications**,** 2024.

25MCE101

DESIGN AND ANALYSIS OF ALGORITHMS
(PROFESSIONAL ELECTIVE-I)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basics of Data Structures and Algorithms

COURSE OBJECTIVES: This course aims to

1. Provide an introduction to understand, analyze the time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.

COURSE OUTCOMES: After completion of the course, the students will be able to

1. Recognize and apply asymptotic notations to analyze the performance of algorithms
2. Apply Divide & Conquer approach and Greedy strategies to solve application-oriented problems
3. Apply e dynamic programming techniques to solve optimization problems and evaluate the performance of graph traversal algorithms.
4. Develop backtracking and branch-and-bound techniques to solve combinatorial and decision problems and evaluate their efficiency.
5. Demonstrate NP-completeness through problem reductions and classify problems into appropriate complexity classes.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	2	3	2	1	1	1
CO3	2	3	3	1	1	1
CO4	2	3	3	1	1	1
CO5	3	2	1	1	1	1

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT-I

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs.

Analysis of Elementary Data Structures: Stacks, Queues, Trees, Dictionaries, Priority Queues, Sets and Disjoint Set Union.

UNIT-II

Divide and Conquer: General Method, Finding the Maximum and Minimum, Analysis of recursive algorithms through recurrence relations - Merge Sort, Quick Sort, Stassen's Matrix Multiplication. Greedy Method: General method, Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Optimal Storage on Tapes, Optimal Merge Patterns.

UNIT-III

Dynamic Programming: General Method, Multistage Graphs, All-Pairs Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, Traveling Salesmen Problem.

Basic Traversal and Search Techniques: Breadth First Search (DFS) and Traversal, Depth First Search (DFS) and Traversal, Connected Components and Spanning Trees, Bi-connected Components and DFS.

UNIT-IV

Backtracking: General Method, 8-Queen's Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycles, Knapsack Problem.

Branch and Bound: The general method, FIFO branch and bound, LC branch and bound, 0/1 Knapsack Problem using FIFO branch and bound, Travelling Salesperson problem using LC branch and bound.

UNIT -V

Theory of NP-Completeness: Polynomial time, Polynomial time verification, P, NP, NP-hard and NP-Complete classes, NP-Completeness and Reducibility. Standard NP-Complete Problems and Reduction Techniques.

Text Books:

1. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2008.
2. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 4th Edition, 2022.

Suggested Reading:

1. R. Pannerselvam "Design and Analysis of Algorithms", PHI, 2007.
2. Hari Mohan Pandey, "Design and Analysis of Algorithms", University Science Press, 2009.
3. Anany Levitin "Introduction to the Design & Analysis of Algorithms", Pearson Education, 2003.
4. Parag H.Dave, Himanshu B. Dave "Design and Analysis of Algorithms", Pearson Education, 2nd Edition, 2014.

25MCE102

BUSINESS ANALYTICS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basic statistics and probability, Spreadsheet proficiency and understanding of business fundamentals

COURSE OBJECTIVES: The course aims to

1. Provide a strong foundation in business analytics concepts, tools, and techniques, including spreadsheets, statistics, optimization, machine learning, and visualization.
2. Apply analytical frameworks to real-world business problems for effective decision-making, market insights, and strategic planning

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

1. Outline the historical development of business analytics from its origins to the present day.
2. Demonstrate proficiency in using Excel for data manipulation, formula application, and data queries.
3. Formulate and solve linear optimization models.
4. Analyze market data using frameworks like PESTLE and Porter's Five Forces to gain strategic insights.
5. Implement strategies for effective Master Data Management to ensure data consistency and accuracy across organizations.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	2	1	1	1
CO2	1	2	3	1	1	1
CO3	1	2	2	1	1	1
CO4	2	2	2	1	1	1
CO5	2	3	3	1	3	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT – I

Introduction to Business Analytics: Evolution, scope, data types, models, problem-solving, analytics integration, competitive advantage, types of analytics (descriptive, predictive, prescriptive), dashboards, analytics process cycle.

UNIT – II

Analytics on Spreadsheets: Basic Excel, formulas, functions, data queries. Descriptive Analytics: Populations, samples, notations, measures of location, dispersion, association. Statistical Inference: Hypothesis testing, one/two-sample tests, ANOVA. Predictive Analytics: Simple/multiple regression, residual analysis, categorical variables.

UNIT – III

Machine Learning: Supervised/unsupervised learning, clustering, segmentation, association analysis, data reduction. Visual Analytics: Data visualization. Prescriptive Analytics: Linear optimization models, spreadsheet implementation, solving models.

UNIT – IV

Marketing Analytics: Models, metrics, data sources, market sizing, PESTLE, Porter's Five Forces, basket analysis, text analytics, and spreadsheet modelling. Sales Analytics: E-commerce modes, sales, profitability, and support metrics.

UNIT – V

Introduction to Big Data: Master data management, types of data/patterns, technologies, applications, issues. Data Understanding: Data objects, attribute types, statistical descriptions, visualization, similarity /dissimilarity measures.

Text Books:

1. Vernon Richardson and Marcia Watson, Introduction to Business Analytics, McGraw Hill Publication, 1st Edition 2023.
2. Sanjiv Jaggia, Alison Kelly, Kevin Lertwachara, and Leida Chen, Business Analytics (2025), McGraw Hill, 2nd Edition 2025.

Suggested Reading:

1. Richard Huntsinger, Business Analytics: Methods and Cases for Data-Driven Decisions, Cambridge University Press, 2025.
2. Brennan Davis, Business Analytics Stukent, Incorporat, 2025.

25MCE103

FREE AND OPEN SOURCE TECHNOLOGIES

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Programming for problem solving, Object Oriented Programming.

COURSE OBJECTIVES: This course aims to

1. Provide an understanding of the concepts, history, and philosophy of Free and Open Source Software (FOSS), including licensing, communities, and business models.
2. Develop practical skills in using, installing, and configuring open source operating systems, tools, databases, programming languages, and web technologies

COURSE OUTCOMES: After completion of this course, student will be able to

1. Apply the principles, history, and licensing of open source software.
2. Analyze open source operating systems and tools.
3. Develop programs using open source programming languages and frameworks.
4. Make use of open source databases and CMS for application development.
5. Evaluate the role of open source in software development, business, and research.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	1	1
CO2	3	2	2	1	1	1
CO3	2	2	2	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	2	1	1	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT - I

Introduction to Free and Open Source Software, Definition of Free Software and Open Source Software, History and evolution of FOSS, Philosophy of the Free Software Foundation (FSF) and the Open Source Initiative (OSI) , Advantages and disadvantages of FOSS, Overview of free software licenses (GNU GPL, LGPL, BSD, Apache, MIT, MPL) and Open source development models.

UNIT – II

Open Source Operating Systems : Introduction to Linux and GNU/Linux distributions, Linux architecture and kernel basics, Linux installation and package management (RPM, DEB, YUM, APT), Linux command line essentials, Shell scripting basics and System administration in Linux

UNIT – III

Open Source Development Tools : Open source compilers and interpreters (GCC, G++, Python, PHP), Version control systems: Git and GitHub basics, Open source IDEs (Eclipse, NetBeans, VS Code), Open source debugging and profiling tools and Makefiles and build automation tools

UNIT – IV

Open Source Databases and Web Technologies : Introduction to MySQL, MariaDB, and PostgreSQL, Database installation, configuration, and administration, SQL basics and advanced queries, Introduction

to PHP and Python web frameworks (Django, Flask) and Open source content management systems (WordPress, Drupal, Joomla)

UNIT – V

Open Source Communities, Trends, and Case Studies : Role of communities in open source development, Contribution guidelines and code repositories, Business models in open source (support, dual licensing, SaaS), Government policies and open source adoption in India and worldwide, Open source success stories (Linux, Apache, Mozilla, Android, LibreOffice) and Future of open source technologies

Text Books:

1. Kailash Vadera, Bhavyesh Gandhi "Open Source Technology", University Science Press, 1st Edition, 2009.
2. Fadi P. Deek and James A. M. McHugh, "Open Source Technology and Policy", Cambridge University Press.

Suggested Reading:

1. Wale Soyinka, "Linux Administration- A beginner's Guide", Tata McGraw Hills.
2. Andrew M. St. Laurent, "Understanding Open Source and Free Software Licensing", O'Reilly Media.
3. Dan Woods, Gautam Guliani, "Open Source for the Enterprise", O'Reilly Media.
4. Bernard Golden, "Succeeding with Open Source", Addison-Wesley Professional.
5. Clay Shirky and Michael Cusumano, "Perspectives on Free and Open Source Software", MIT press.

25MCE104

DIGITAL MARKETING AND E-COMMERCE

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basic understanding of marketing principles and business processes, be familiar computer applications, search engines and online communication tools

COURSE OBJECTIVES: The course aims to

1. Understand the fundamental concepts, evolution, and scope of digital marketing and e-commerce and analyze consumer behavior in the digital environment and the impact of technology on buying decisions.
2. Develop skills to design and implement social media, email, mobile, and emerging digital marketing strategies and apply relevant tools, techniques, and platforms for effective digital campaigns.
3. Examine various e-commerce business models, payment systems, and security practices.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Explain the concepts, strategies, applications, and benefits of digital marketing and e-commerce.
2. Analyze consumer behavior patterns and derive marketing intelligence from online user data.
3. Design and implement effective social media and emerging platform marketing strategies.
4. Utilize tools and techniques for email marketing, mobile marketing, and AI/VR-based campaigns.
5. Evaluate e-commerce business models, payment systems, and operational mechanisms for online business.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	2	2
CO2	2	3	2	2	2	1
CO3.	1	2	3	3	2	2
CO4	2	2	3	3	1	2
CO5	2	3	2	2	3	2

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT I

Introduction to Digital Marketing: Evolution of digital Marketing, Traditional vs Digital Marketing, Digital Marketing Channels, Digital Marketing Plan, Digital Marketing Strategy, Digital Marketing Application and Benefits, Digital Marketing in India.

UNIT II

The Consumer and Digital Marketing: Consumer Behavior on internet, Impact of Digital Technology on Consumer Behaviour, Attributes of online buying behavior, Marketing Intelligence from user's online data understanding consumer demands, brand building on web.

UNIT III

Social Media Marketing: Social Networking, Objectives of Social Media Strategy , Building social media strategy, Types of Social media marketing , Facebook marketing , LinkedIn marketing, Instagram

marketing, You tube Marketing, Twitter Marketing,

UNIT IV

Emerging Platforms of digital marketing: E-mail marketing, Mobile marketing, Video Marketing, Artificial intelligence and virtual Reality in Digital Marketing.

UNIT V

Introduction to E-Commerce: Meaning of electronic commerce, business applications of ecommerce, comparison with traditional commerce. Business Models in E-Commerce-e-shops, e-procurement, e-auctions, value chain integrators, information brokerage, telecommunication, collaboration platforms, etc.; Electronic payment system; E-Banking-Concept, operations, online fund transfer-RTGC, ATM, etc.,

Text Books:

1. Gupta Seema (2020), Digital Marketing, Mc Graw Hill Publications.
2. 2. Puthussery Antony (2020), Digital Marketing. Notion Press.

Suggested Reading:

1. Bhatia Puneet (2019), Fundamentals of Digital Marketing, Pearson Publications.
2. Greenstein, Electronic Commerce, Tata McGraw Hill, New Delhi. 5. Norton, Peter: Introduction to Computer 4/E, Tata McGraw Hill (P) Ltd., New Delhi.

25MCC110

DATABASE MANAGEMENT SYSTEMS LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Knowledge of programing skills**,** Concepts of Database Management System

COURSE OBJECTIVES: This course aims to

1. Gain familiarity with the concepts of structured query language.
2. Understand about PL/SQL.and MongoDB

COURSE OUTCOMES: After completion of this course, student will be able to

1. Experiment with SQL commands.
2. Apply integrity constraints on a database.
3. Build the views with multiple options.
4. Develop PL/SQL programs using stored procedures, functions, cursors and packages.
5. Create Mango DB and perform basic operations.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	3	3	3
CO2	3	2	3	2	2	2
CO3	3	3	2	2	2	3
CO4	3	3	2	3	1	2
CO5	3	2	3	3	2	3

1 - Slightly, 2 - Moderately, 3 – Substantially

List of Programs

I. SQL

1. Creating tables using commands in DDL
2. Manipulating the data using DML
3. Apply the built-in function and write simple queries on various databases
4. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
5. Using Aggregate functions Set operators
6. Simple condition query creation using SQL Plus
7. Complex condition query creation using SQL Plus
8. Exercising all types of Joins, views
9. Exercising Data Control Language and Transaction Control Language

II. PL/SQL

9. Demonstration of Blocks
10. Cursors, implicit and explicit
11. Procedures,
12. Functions
13. Packages.
14. Creation of Triggers
15. Create a sample MongoDB and basic operations

Suggested Reading:

1. Silberschatz, Korth, Sudarshan, Database System Concepts, 7th Edition, McGraw Hill, 2020
2. Nilesh Shah "Database Systems Using Oracle", PHI, 2016.
3. Rick F Van der Lans "Introduction to SQL", 4th Edition, Pearson Education, 2007.
4. Benjamin Rosenzweig, Elena Silvestrova "Oracle PL/SQL by Example", 3rd Edition, Pearson Education, 2004.Albert Lulushi, "Oracle Forms Developer's Handbook", Pearson Education.

25MCC111

WEB TECHNOLOGIES LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Knowledge of programming fundamentals and web basics

COURSE OBJECTIVES: This course aims to

1. Gain knowledge of developing web pages
2. Learn building applications using latest Technologies

COURSE OUTCOMES: After completion of this course, student will be able to

1. Develop static web pages.
2. Show the documents in professional way.
3. Construct interactive web pages.
4. Examine client side validations.
5. Build web applications using React JS.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	3	3
CO2	2	2	3	2	3	3
CO3	2	2	3	2	3	
CO4	2	2	3	2	3	
CO5	2	2	3	2	3	3

1 - Slightly, 2 - Moderately, 3 – Substantially

HTML5

1. Text, Markup Tags, Formatting tags
2. Images., colors and canvas
3. Hyperlinks., internal , external hyper links
4. Ordered and Unordered Lists, Nested list
5. Tables and Nested Tables
6. Multimedia
7. Forms: student registration form, patient registration form

JAVASCRIPT

8. Selection statements, switch statements and loop statements: student grade, prime perfect
9. Pre-defined objects (Date, String, Math etc.,).
10. Functions.: Factorial, recursion
11. Array object.: sorting: Bubble sort, Selection sort
12. User-defined objects
13. Handle various events occurred in the HTML document
14. Positioning elements, moving elements, elements visibility,

	stacking elements and slow movement of elements.
CSS	15. Inline Stylesheet, Internal Stylesheet. External Stylesheet and Pseudo
	16. Backgrounds, and color Gradients, Fonts and Text styles, Creating Boxes & columns
	17. Positioning and Floating an element, List styles, Table Layouts , frames and controls
XML	18. Store the information in the XML Documents: patient information
	19. CSS style sheets for the XML documents
REACT JS	20. Components, React DOM, Handler Function in JSX, props, state
	21. Hooks, Custom Hooks, React Fragments, Asynchronous Data
	22. Data Fetching & Re-Fetching, Forms: Patient Information
	23. Class component, CSS , SVG's: Apply styles and icons, buttons for student information

Suggested Reading:

1. HTML 5 Black Book, DT Editorial Services, DreamTech Press, 2019
2. Robin Wieruch, "The Road to React: Your journey to master plain yet pragmatic React" , 2020-04-20

25MCC112

OPERATING SYSTEMS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Operating system Concepts and Programming for problem solving Using C

COURSE OBJECTIVES: This course aims to

1. Learn basic shell programs, programs on process scheduling algorithms
2. Learn programs on Inter process Communication, programs on synchronization problems, programs on Page Replacement algorithms and files

COURSE OUTCOMES: After completion of the course, the students would be able to:

1. Implement basic shell programs
2. Build programs on process scheduling algorithms
3. Implement programs on Inter process Communication.
4. Build programs on synchronization problems
5. Implement programs on Page Replacement Algorithms and files.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	1
CO2	2	2	2	1	1	1
CO3	2	2	2	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	1	1	1	2

1 - Slightly, 2 - Moderately, 3 – Substantially

List of Programs:

1. Basic shell scripts.
2. Construct a C program for fork system call.
3. Implement a C program for FCFS scheduling algorithm.
4. Implement a C program for SJF scheduling algorithm.
5. Implement a C program for PRIORITY scheduling algorithm.
6. Implement a C program for Round - Robbin scheduling algorithm
7. Construct a C program for IPC by using pipes
8. Construct a C Program for Echo server-using pipes.
9. Construct a C Program for Echo server-using message Queues.
10. Implement a C Program for Producer & Consumer Problem using Semaphores
11. Construct a C Program for Readers & Constructrs Problem using Semaphores
12. Implement a C Program for Dining Philosopher’s problem using semaphores.
13. Construct a C Program for FIFO Page Replacement algorithm.

14. Construct a C Program for LRU Page Replacement algorithm
15. Construct a C program for printing home directory Path of the current user
16. Construct a C program for printing password information of the current user by user id or user name
17. Construct a C program for Create and construct the contents and red the contents of file
18. Construct a C program for Copying content of one file to another file

Suggested Reading:

1. W. Richard Stevens, "Unix Network Programming", Pearson Education Inc, PHI Learning 1990.
2. Behrouz A. Forouzan, Richard F. Gilberg, "UNIX and Shell Programming: A Textbook", Books/Cole-Thomson Learning, 2003.
3. Yashvant Kanetkar “Let Us C “, BPB Publication, 15th Edition -2018.

25MCC113

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Knowledge on linear algebra, algorithms.

COURSE OBJECTIVES: This course aims to:

1. To get the students acquainted with the concepts of different searching techniques of AI systems.
2. To understand the various Machine Learning Algorithms.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Define the concept of Artificial Intelligence.
2. Apply real life problems in a state space representation so as to solve them.
3. Understand the features of machine learning to apply on real world problems.
4. Compare and contrast Classification and Regression problems.
5. Apply unsupervised learning algorithms to solve real world problems.

CO-PO Articulation Matrix

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

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT – I

Introduction: Foundations of AI, History, State of the Art, Risks and Benefits. Intelligent agents: Agents and Environment, The Concept of Rationality, Structure of an Agent. Solving problems by Search: Problem-Solving Agents, State space representation, Search graph and Search tree searching for Solutions.

UNIT – II

Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth- first search, Iterative deepening Depth-first search, Bidirectional search. Informed (Heuristic) Search Strategies: Heuristic Functions, Hill- climbing, Greedy best-first search, A* search, Adversarial Search: Game Theory, Alpha–Beta Pruning, Constraint Satisfaction Problems.

UNIT - III

Machine Learning: What is Machine Learning, Types of Machine Learning Algorithms- Supervised, Unsupervised and Reinforcement Learning. Feature Selection and Feature Engineering: Data sets, Creating training and test sets, managing categorical data, missing features, data scaling and normalization, Whitening, Feature selection and filtering, PCA, Visualization of high-dimensional datasets; Regression Algorithms: Linear models for regression, Regression types, Evaluation Metrics, Hyper parameter tuning, Grid and Random search.

UNIT – IV

Linear Classification Algorithms: KNN, logistic regression, classification metrics, ROC curve. Naïve Bayes: Bayes theorem, Naïve Bayes classifiers- Multinomial, Bernoulli and Gaussian. Support Vector Machines: Linear SVM, Kernel-based classification. Decision Trees and Ensemble Learning: Binary Decision trees, Introduction to Ensemble Learning-Bagging, Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier.

UNIT – V

Clustering Fundamentals: Basics, Gaussian mixture, K-means, Evaluation methods, DBSCAN, Spectral Clustering, Hierarchical Clustering. Introduction to Neural Networks: Introduction to deep learning, MLPs with Keras, deep learning model layers, Introduction to Tensorflow.

Text Books:

1. Russell, Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Ed., 2015.
2. Giuseppe Bonaccorso, "Machine Learning Algorithms", 2nd Edition, Packt, 2018

Suggested Reading:

1. Tom M. Mitchell, "Machine Learning", 4 th Ed., McGraw Hill, 2017.
2. Rich, Knight, Nair, "Artificial Intelligence", 3 rd Ed., Tata McGraw Hill, 2017.
3. Puneet Mathur, "Machine Learning Applications Using Python: Cases Studies from Healthcare, Retail, and Finance", 1st Ed., Apress, 2019.
4. Stephen Marsland, Machine Learning - An Algorithmic Perspective, 2nd Ed., CRC Press, 2014.
5. Saroj Kaushik, "Artificial Intelligence", 1st Ed., Cengage Learning India, 2011.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs88/preview
2. https://www.geeksforgeeks.org/machine-learning/

25MCC114

SOFTWARE ENGINEERING AND DEVOPS

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Basic Knowledge of programming, Database Management Systems, Web Technologies

COURSE OBJECTIVES: This course aims to

1. To provide an understanding of the working knowledge of the techniques for analysis, design, testing and quality management of large software development projects.
2. To get acquainted with process models, software requirements, software design, software testing, software process, risk management, quality management, software configuration management and DevOps & Automation.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Identify the basics of software engineering principles and importance of software requirements specification.
2. Acquire the knowledge and requirement of software development models.
3. Classify the importance of software design and architecture principles and models.
4. Acquaint with the software testing approaches and levels of testing, software configuration management, software maintenance activities
5. Analyze the concepts of DevOps & Automation, DevOps Fundamentals & Core Principles

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	1	1	1
CO2	2	2	3	1	2	2
CO3	1	2	2	2	3	3
CO4	1	1	2	2	3	2
CO5	1	2	1	1	1	2

UNIT I

Introduction to Software Engineering, Software Engineering Paradigm: Definition, Software Crisis, Software Process Models (Waterfall, Incremental, RAD, Prototyping, Spiral. Agile Development).

UNIT II

Software Requirements & Specification Requirement Engineering: Feasibility Study, Elicitation, Analysis, Documentation. Software Requirement Specification (SRS): IEEE Standard, Requirements Validation, Requirements Management. Modeling with UML: Use Case Diagrams, Activity Diagrams, Class Diagrams.

UNIT III

Software Design & Project Management Design Concepts: Abstraction, Modularity, Cohesion, Coupling. Function-Oriented Design. Software Project Management: Risk Management, Project Scheduling, Estimation (COCOMO Model).

UNIT IV

Software Testing & Maintenance Testing Fundamentals: White-box vs. Black-box testing. Testing

Levels: Unit Testing, Integration Testing, System Testing, Acceptance Testing. Software Configuration Management (SCM) & Software Maintenance.

UNIT V

Introduction to DevOps & Automation DevOps Fundamentals: Definition, History, Core Principles (Culture, Automation, Measurement, Sharing), DevOps Lifecycle. DevOps vs. Agile: Key differences and how they complement each other. DevOps Toolstack: Version Control.

Textbooks :

1. Software Engineering: R.S. Pressman, Software Engineering: A Practitioner's Approach. 9th Edition - 2023
2. DevOps: Gene Kim, Jez Humble, Patrick Debois, The DevOps Handbook. Second Edition ISBN:978-1-942788-00-3 Published:06 October 2016

Suggested Reading:

1. Software Engineering : Ian Sommerville. — 9th edition 2011

25MCC115

COMPUTER NETWORKS

Instruction	4L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Pre-requisites: Basic Programming and Problem solving, Computer fundamentals

Course Objectives:

1. To understand the principles of data communications and computer networks.
2. To understand routing protocols, transport layer and application layer protocols.

Course Outcomes:

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

1. Interpret the various features of Computer Networks and understand the functions of different layers of ISO model.
2. Analyze the various protocols and Access methods of Data Link layer an MAC sub Layers.
3. Experiment With various Routing Algorithms of Network layer.
4. Apply Transport layer Services and protocols such as TCP, UDP.
5. Identify internals of main protocols such as HTTP, FTP, SMTP and DNS service of Application layer and security issues in computer networking.

CO-PO Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	2	1	1
CO 2	2	3	1	1	1	1
CO 3	2	3	2	1	1	2
CO 4	3	2	2	1	1	2
CO 5	2	3	1	2	2	2

UNIT - I

Networks: Network Criteria, Physical Structure, Network Types, Network models: ISO/OSI model, TCP/IP Protocol Suite, Physical layer: Data and Signals, Transmission Impairment, Performance, Transmission Modes, Transmission Media: Guided media, unguided media.

UNIT-II

Data link Layer: Error detection and Correction: Block coding, CRC, Data Link Control (DLC): DLC Services, Data-Link Layer Protocols, HDLC, Point-to-Point Protocol (PPP), Media Access Control (MAC): Random Access, Controlled Access, Channelization.

UNIT-III

Network Layer: Network-Layer Services, Packet Switching, Network Layer Performance, IPV4 Addressing Network Layer Protocols: Internet Protocol (IP), Unicast Routing: Routing Algorithms, Unicast Routing Protocols, IPV6 Addressing and Protocol, Transition from IPV4 to IPV6.

UNIT-IV

Transport Layer: Transport Layer Services, Connection oriented and Connectionless Protocols, Transport Layer Protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP).

UNIT-V

Application Layer: World Wide Web (WWW) and HTTP, FTP, TELNET, SSH, Domain Name Space (DNS), SMTP, BITTORRENT, Network Security: Security Goals, Attacks, Symmetric and Asymmetric cryptography, Fire walls.

Text Books:

1. Behroz A Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw – Hill, 2013.
2. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011

Suggested Reading:

1. LL Peterson, BS Davie, "Computer Networks: A Systems Approach", 5thEdition, Morgan-Kauffman, 2011.
2. JF Kurose, KW Ross, "Computer Networking: A Top-Down Approach", 5thEdition, Addison-Wesley, 2009.
3. W Stallings, "Cryptography and Network Security, Principles and Practice", 5thEdition,

25MCE105

CLOUD COMPUTING

(PROFESSIONAL ELECTIVE-II)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Operating Systems and Data communications and Computer Networks.

COURSE OBJECTIVES: This course aims to

1. To understand the requirement, demand, technologies used and the Security mechanisms of cloud computing
2. To evaluate the services & various architectures in cloud to meet the clients perspectives

COURSE OUTCOMES: After completion of this course, student will be able to

1. Identify the basic components of cloud computing and resource sharing, the deployment & delivery models in cloud environment to support the client's requirements.
2. Evaluate the technologies and security mechanisms used in cloud computing.
3. Analyze various cloud infrastructure mechanisms, virtual server's role and cloud management mechanisms.
4. Evaluate the role, design and implementation of various cloud architectures to provide the best services.
5. Analyze the role and functionalities of IaaS, PaaS, SaaS services from Cloud provider & consumers perspective, Cost Metrics and Pricing Models , Service Quality Metrics and SLAs.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	3	1
CO2	1	3	3	1	3	3
CO3	2	3	3	1	2	2
CO4	2	3	2	1	3	3
CO5	1	3	3	1	3	2

UNIT-I

Fundamental Cloud Computing-Understanding Cloud Computing, Origins influences, Basic Concepts and Terminology, Goals, Benefits, risks, Challenges, Rolls and boundaries, Cloud characteristics, Cloud Delivery models, Cloud deployment models

UNIT-II

Broadband Networks and Internet Architecture, Data center technology, Virtualization Technology, Web Technology, Multitenant Technology, Cloud Security-basic terms and concepts, Threat agents, Cloud security threats.

UNIT-III

Cloud Infrastructure Mechanisms-Logical network perimeter, Virtual server, Cloud Storage device, cloud usage monitor, Resource replication, Ready-made Environment, Specialized Cloud Mechanisms, cloud management mechanisms, cloud security mechanisms.

UNIT-IV

Cloud Computing Architectures-Work load distribution architecture, Resource pooling architecture, Dynamic scalability architecture, service load balancing architecture, Elastic disk Provisioning Architecture, hyper cluster architecture, load balanced virtual server instances architecture, zero down time architecture, cloud balancing architecture , Resource reservation architecture, Bare-Metal Provisioning Architecture, Rapid provisioning

UNIT-V

Working with cloud perspectives - (Cloud Provider Perspective) Building IaaS Environments, Equipping PaaS Environment, optimizing SaaS Environments. (Cloud consumer perspective)- Working with IaaS Environments, working with PaaS Environment, working with SaaS Environments. Cost Metrics and Pricing Models- Business Cost Metrics , Cloud usage Cost Metrics, Cost Management Considerations. Service Quality Metrics and SLAs- Service Quality Metrics, SLA Guidelines.

Text Books:

1. Thomas Erl, Ricardo Puttini “Cloud Computing: Concepts, Technology & Architecture”, Prentice Hall, 1st Edition, 2014.

Suggested Reading:

1. John W Rittinghouse, James F.Ransome. “Cloud Computing implementation, Management and Security” CRC Press, 2009.
2. Rajkumar Buyya, James Broberge and Anddrzej, M Gosciniski “Cloud Computing Principles and Paradims”. Wiley Publishing, 2011

25MCE106

BIG DATA ANALYTICS
(PROFESSIONAL ELECTIVE-II)

Instruction	3L Hours per week
Duration of Semester-End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Engineering with Python, Business Analytics

COURSE OBJECTIVES: This course aims to

1. To introduce the concepts and challenges of big data, the role of HDFS in handling big data, and Map- Reduce Architecture.
2. To introduce the features of NoSQL and study the working mechanisms of MongoDB, Pig, and Hive

COURSE OUTCOMES: After completion of this course, student will be able to

1. Outline the fundamentals of various big data analytics techniques.
2. Analyze the Map-Reduce programming model for better optimization
3. Develop applications using the Map Reduce framework to solve real-world problems
4. Develop data models using NoSQL Database - MongoDB.
5. Experiment with Big Data applications using Pig and Hive

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	2
CO2	3	3	3	1	2	2
CO3	3	3	2	3	2	2
CO4	3	2	3	1	2	2
CO5	3	3	3	2	2	2

UNIT - I

Big Data : Introduction , Big Data importance, Big Data solutions, Big Data use cases: IT for IT Log Analytics, The Fraud Detection Pattern, Social Media Pattern .The Hadoop Distributed Files system: HDFS Concepts, Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems, Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow, Anatomy of a File Read, Anatomy of a File Write, Coherency Model, Parallel Copying with distcp, Keeping an HDFS Cluster Balanced.

UNIT - II

MapReduce: A Weather Dataset, Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Map and Reduce, Scaling Out, Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Developing a MapReduce Application: Writing a Unit Test with MR Unit, Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job.

UNIT – III

How MapReduce Works: Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side.

UNIT – IV

No SQL Databases: Review of traditional Databases, Introduction to Nosql databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, Working mechanisms of Mongo DB**:** Overview, Advantages, Environment, Data Modeling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation.

UNIT – V

Pig: Installing and Running Pig, an Example, Comparison with Databases, Pig Latin, User- Defined Functions, Data Processing Operators, Pig in Practice, parallelism. **Hive**: Installing Hive, The Hive Shell, An Example, Running Hive, Configuring Hive , Hive services, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions.

Text Books:

1. Paul C. Zikopoulos, Chris Eaton, Dirk DeRoos, Thomas Deutsch, George Lapis, "Understanding Big Data - Analytics for Enterprise class Hadoop and Streaming Data", McGrawHill, 2012.
2. Kristina Chodorow, “MongoDB: The Definitive Guide-Powerful and Scalable Data Storage”, 2nd Edition, O'Reilly Media, 2013

Suggested Reading:

1. Chuck Lam, Mark Davis, AjitGaddam, “Hadoop in Action”, Manning Publications Company, 2016.
2. Alex Holmes,” Hadoop in Practice”, Manning Publications Company, 2012.
3. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
4. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O’Reilly Media Inc, October 2012.
5. Vignesh Prajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.

25MCE107

DISTRIBUTED APPLICATION DEVELOPMENT
(PROFESSIONAL ELECTIVE-II)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Software Engineering, Web Technologies

COURSE OBJECTIVES: This course aims to

1. To provide good understanding of latest web technologies on client side components like ReactJS, Angular, web frameworks, develop server side web applications like Node.js and Express.
2. To develop innovative web applications using various technologies.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Understand the database connectivity and application servers.
2. Explore the type of forms with validations using ReactJS.
3. Utilize Express framework to develop responsive web applications.
4. Demonstrate the architecture and file system of NodeJs.
5. Identify the significance of component intercommunication with Angular

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	1
CO2	1	2	3	1	1	1
CO3	2	3	3	1	1	2
CO4	2	2	2	1	1	2
CO5	1	2	3	2	1	2

UNIT - I

Introduction to Full stack development and NoSQL MongoDB: Basics, Configuring Server and Client, MongoDB Compass, Creating Database, MongoDB Commands, MongoDB CRUD Operations. REST: Introduction to REST and API, REST Constraints, Representations, Resource Identifier, REST Actions, Status Codes.

UNIT - II

NodeJs: Introduction, NodeJS Features and Drawbacks, setup Environment for NodeJs, NodeJS Program architecture, NodeJS Web Server, NodeJS Global Objects, NodeJS OS Objects, NodeJS Error Handling, Node JS Event Loop, NodeJS File System, Async and Sync, Connecting with Database, Handling CRUD Operations.

UNIT - III

Building an Express web application: Introduction to Express, Installation of Express, Create first Express application, the application request and response objects, configuring an Express application, rendering views, Authentication, Authorization.

UNIT - IV

Introduction to ReactJS: React Components, React State and Props Component intercommunication: Component Composition, pass data from parent to child, pass data from child to parent, Fetching data API using axioms, Types of forms, Form Validations, Posting Data, React Router, Building & Deploying React App.

UNIT - V

Introduction to Angular2: Angular2 Architecture (Component-Based Architecture), Consuming API, State Management, Validation, Routing. Passing data from parent to child and Passing data between siblings. Angular2 Specific**:** Directives, Modules, Components, Observables, Binding, Pipes, Dependency Injection.

Text Books:

1. Amos Q. Haviv, MEAN Web Development, Second Edition, Packt Publications, November 2016.
2. Vasan Subramanian, "Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node", 2nd Edition, APress.

Suggested Reading:

1. Fernando Doglio, "REST API Development with Node.js", 2nd Edition, A Press.

25MCE108

SOFT COMPUTING
(PROFESSIONAL ELECTIVE-II)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Artificial Intelligence and Machine learning

COURSE OBJECTIVES: This course aims to

1. To Introduce and use the idea of fuzzy logic and use of heuristics based on human experience
2. To Familiarize the Neuro-Fuzzy modeling using Classification and Clustering techniques

COURSE OUTCOMES: After completion of this course, student will be able to

After completion of the course, students would be able to:

1. Elaborate the Evolutionary Computing.
2. Applications of Feed forward Neural Network
3. Summarize the uses of Associative Memory and Unsupervised Learning
4. Analyze the Classical Sets and Fuzzy Sets
5. Perform various operations on Rough Sets

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	2
CO2	3	3	2	1	1	2
CO3	2	3	2	1	1	2
CO4	3	3	1	1	2	2
CO5	3	3	2	1	2	3

UNIT – I

Introduction to Soft Computing: Evolutionary Computing, "Soft" computing versus "Hard" computing, Soft Computing Methods, Recent Trends in Soft Computing, Fundamentals of Artificial Neural Network (ANN) : Introduction , Model of Biological Neuron , Mathematical Model of Neuron , ANN Architecture, Learning Rules, Learning Paradigms, Perceptron Network, Adaline and Madaline Networks, Applications of Neural Network.

UNIT –II

Feed forward Neural Network : Introduction , Back Propagation Network, Parameter Selection in Back Propagation Network, Local Minima and Global Minima, Merits and Demerits of Back Propagation, Variants of Back Propagation, Applications of Back Propagation Network, Applications of Radial Basis Function

UNIT –III

Associative Memory: Introduction, Auto associative Memory, Hetero-associative Memory, Bidirectional Associative Network, Applications of Associative Memory. Unsupervised Learning : Introduction, WinnerTakes-All Network, Learning Vector Quantization, Self-organization Map, Adaptive Resonance Theory, Neocognitron, Applications of Unsupervised Learning

UNIT –IV

Classical Sets and Fuzzy Sets : Crisp Sets , Fuzzy Sets: History and Origin , Fuzzy Sets: Basic Concepts Paradigm Shift , Representations of Fuzzy Sets , Alpha-cuts , Basic Operations on Fuzzy Sets, Fuzzy Complements, Intersections, and Unions , Extension Principle for Fuzzy Sets , Intuitionistic Fuzzy Sets, Operations on Intuitionistic Fuzzy Sets, Alpha–Beta Cuts Crisp Relations and Fuzzy Relations : Crisp

Relations, Fuzzy Relations , Binary Fuzzy Relations , Intuitionistic Fuzzy Relations.

UNIT –V

Rough Sets: Fundamentals of Rough Set Theory, Rough Approximations, Properties of Approximations, Measures of Accuracy, Topological Characterization of Imprecision, Rough Membership Function, Attribute Reduction , Approximation of Classification, Dependency of Knowledge, Rough Sets, Rule Induction, and Discernibility Matrix , Knowledge Representation, Knowledge Representation Systems, Decision Tables, Rule Induction , Discernibility Matrix.

Text Books:

1. Soft Computing – Advances and Applications - B.K. Tripathy and J. Anuradha – Cengage Learning - 2015

Suggested Reading:

1. S. N. Sivanandam & S. N. Deepa, “Principles of Soft Computing”, 2nd edition, Wiley India, 2008.
2. David E. Goldberg, “Genetic Algorithms-In Search, optimization and Machine learning”, Pearson Education.
3. J. S. R. Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education, 2004.

25MCE109

INTERNET OF THINGS
(PROFESSIONAL ELECTIVE-III)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: Computer Architecture, Programming for Problem Solving.

COURSE OBJECTIVES: This course aims to**:**

1. Understand the individual components of IoT.
2. Impart necessary and practical knowledge in Internet of Things.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Describe Internet of Things and basics components.
2. Illustrate working of I/O devices, sensors & communication module.
3. Analyse the use of protocols in IoT.
4. Explain the Interfacing of I/O devices, Sensors & communication module
5. Determine the Market perspective of IoT and Domain Specific Applications

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	1	1	1	2
CO 2	2	3	3	1	1	1
CO 3	2	3	2	1	1	2
CO 4	2	3	3	1	1	1
CO 5	1	2	2	2	3	3

UNIT – I

Introduction to Internet of Things: Introduction, , Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies**. IOT and M2M:** Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT.

UNIT – II

IoT Systems – Logical Design using Python: Introduction, Python Data Types and Data Structures, Python Packages of Interest for IoT. IoT Physical Devices and Endpoints: What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, and Programming Raspberry Pi with Python.

UNIT - III

Design Principles for Web Connectivity: Introduction, Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, MQTT, COAP , Web Connectivity for Connected-Devices Network using Gateway, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Introduction, Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and others

UNIT - IV

Data Acquiring, Organising, Processing and Analytics: Introduction, Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes. Data Collection, Storage and Computing Using a Cloud Platform: Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models.

UNIT – V

Domain Specific IOTs: Introduction, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle. IoT Privacy, Security and Vulnerabilities Solutions: Introduction**,** Vulnerabilities, Security Requirements and threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT

Text Books:

1. Arsheep Bahga, Vijay Madisetti, Internet Of Things: A Hands-On Approach Paperback, Universities Press, Reprint 2020
2. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw Hill Education, Reprint 2018.

Suggested Reading:

1. Perry Lea, Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publications, Reprint 2018.
2. Amita Kapoor, “Hands on Artificial intelligence for IoT”, 1st Edition, Packt Publishing, 2019.

Online References:

1. https://owasp.org/www-project-internet-of-things/
2. NPTEL: Sudip Misra, IIT Khargpur, Introduction to IoT: Part-1, https://nptel.ac.in/courses/106/105/106105166/

25MCE110

USER INTERFACE AND USER EXPERIENCE DESIGN
(PROFESSIONAL ELECTIVE-III)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Fundamental Computer Skills, Knowledge of Web Technologies.

COURSE OBJECTIVES: This course aims to

1. Familiarize students with the fundamental principles and concepts of user interface (UI) and user experience (UX) design..
2. Understand the importance of applying user-centered design methods throughout the design process.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply user-centered design principles to create interfaces that meet the needs and preferences of target users.
2. Demonstrate proficiency in designing intuitive user interfaces that are easy to navigate and understand.
3. Develop the skills to create wireframes, prototypes, and mockups using industry-standard design tools.
4. Gain an understanding of accessibility guidelines and principles, designing interfaces that are accessible to users with disabilities.
5. Identify emerging trends and technologies in UI/UX design.

CO-PO Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	3	2	2	2
CO 2	1	2	3	3	1	2
CO 3	2	2	3	2	1	2
CO 4	1	2	2	2	3	2
CO 5	1	2	2	1	1	3

UNIT - I

Introduction to UI/UX Design: Understanding UI/UX Design, Definition and importance of UI/UX design, Difference between UI and UX, Roles and responsibilities of UI/UX designers, Overview of the design process. User-Centered Design Principles: Principles of user-centered design, User research methods (interviews, surveys, and observations), Creating user personas and scenarios, conducting user journey mapping exercises.

UNIT – II

Design Fundamentals: Basic principles of visual design (layout, typography, color), Gestalt principles and their application in UI design, Applying visual hierarchy to improve user experience, Introduction to design tools (Sketch, Figma, Adobe XD).

Interaction Design: Principles of interaction design, Designing effective navigation systems, Feedback mechanisms and user affordances Prototyping techniques for interaction design.

UNIT - III

Usability and User Testing: Understanding usability principles, Nielsen's heuristics for user interface design, conducting heuristic evaluations of UI designs, Usability testing methods (moderated vs. unmoderated, remote testing).

User Testing and Feedback: Planning and conducting usability tests, Analyzing usability test results incorporating user feedback into UI design iterations, Best practices for iterative design and testing cycles.

UNIT - IV

Accessibility in UI/UX Design: Understanding accessibility guidelines (WCAG), Designing accessible interfaces for users with disabilities, Assistive technologies and their impact on UI/UX design

Emotional Design and Engagement: Principles of emotional design, creating emotionally engaging user experiences, Strategies for enhancing user engagement and retention, Case studies of emotionally successful UI/UX designs

UNIT - V

Responsive and Mobile Design: Principles of responsive web design, Mobile-first design approach, Adapting layouts and content for different screen sizes, Testing and debugging responsive designs

Designing for Mobile Platforms: Mobile UI design patterns and conventions, Navigation and interaction patterns for mobile apps, Challenges and best practices for designing mobile interfaces, Introduction to mobile prototyping tools (InVision, Marvel)

Text Books:

1. Krug, S. “Don’t Make Me Think”, 3rd Edition, Rider publication, 2014.
2. Don Norman, "The Design of Everyday Things", 2nd Edition, Basic Books, 2013.

Suggested reading:

1. Jim K., “Design Basics Index”, How Books, 2010.
2. Lidwell, W., Holden, K. and Butler, J. “Universal Principles of Design”, Rockport Publishers, 2010.

Online Resources:

1. User Interface Design - Course (nptel.ac.in)
2. Introduction to User Experience Design Course (Georgia Tech) | Coursera.

25MCE111

SOFTWARE REUSE TECHNIQUES
(PROFESSIONAL ELECTIVE-III)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: software engineering.

COURSE OBJECTIVES: This course aims to
1. Knowledge on various kinds of design patterns and structural patterns.
2. Methods involved in the various kinds of behavioral patterns and architectural patterns.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Application of reuse driven software engineering business.
2. Usage of various techniques involved in design and creational patterns.
3. Employment of structural patterns for suitable scenarios.
4. Utilization of behavioral patterns for suitable schemas.
5. Justify architectural patterns for software for a business model.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	2	2
CO2	2	2	3	1	2	3
CO3	2	3	3	1	2	2
CO4	2	3	2	1	2	2
CO5	2	3	3	1	2	2

UNIT – I

Software reuse success factors, Reuse driven software engineering business, object oriented Software engineering, Applications and Component subsystems, Use case components, object Components.

UNIT – II

Design Patterns – Introduction. Creational Patterns – Factory, factory method, abstract factory, singleton, builder prototype.

UNIT – III

Structural Patterns – Adapter, bridge, composite, decorator, facade, flyweight, proxy. Behavioral Patterns – Chain of responsibility, command, and interpreter.

UNIT – IV

Behavioral Patterns – Iterator, mediator, memento, observer, state, strategy, template, visitor, other design patterns – Whole part, master-slave, view handler, forwarder – receiver, client – dispatcher-server, publisher-subscriber.

UNIT – V

Architectural Patterns – Layers, pipes and filters, black board, broker, model-view controller, presentation – abstraction-control, micro kernel, reflection.

Text Books :

1. Ivar Jacobson, Martin Griss, Patrick Hohnson – Software Reuse. Architecture, Process and Organisation for Business Success , Addison-Wesley. 1997
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides – Design Patterns –Addison, Pearson Education, Addison-Wesley.

Suggested Reading:

1. Software Reuse: Methods, Models, Costs, second edition by Ronald J. Leach. Software Reuse Techniques: Adding Reuse to the System Development Process 1st Edition by Carma McClure(Author).

25MCE112

SOCIAL NETWORK ANALYSIS
(PROFESSIONAL ELECTIVE-III)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Business Analytics

COURSE OBJECTIVES: This course aims to
1. To know various social network mining techniques
2. To identify the suitable graph for implementing social network.

COURSE OUTCOMES: After completion of this course, student will be able to
After completion of the course, students would be able to:
1. Remember the basic concepts of social networks
2. Apply the various Ranking Algorithms
3. Understand the fundamental concepts in analysing the large-scale data that are derived from social networks
4. Implement mining algorithms for social networks
5. Perform mining on large social networks and illustrate the results.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	2	1
CO2	3	2	1	1	2	1
CO3	2	3	1	1	1	1
CO4	3	3	3	1	1	1
CO5	2	3	3	2	1	2

UNIT I

Introduction to Social Network Mining: Graph Models and Node Metrics. Introduction to social network mining. Illustration of various social network mining tasks with real-world examples. Data characteristics unique to these settings and potential biases due to them. Social Networks as Graphs. Random graph models/ graph generators, degree distributions. Models of evolving networks. Node based metrics, ranking algorithms (PageRank). Gephi graph visualization and exploration software – practice.

UNIT II

Social-Network Graph Analysis: Social network exploration/ processing: graph kernels, graph classification, clustering of social-network graphs, centrality measures, community detection and mining, degeneracy (outlier detection and centrality), partitioning of graphs. SNAP system for large networks analysis and manipulation.

UNIT III

Social-Network Graph Analysis and Properties: Social network exploration/ processing and properties: Finding overlapping communities, similarity between graph nodes, counting triangles in graphs, neighborhood properties of graphs. Pregel paradigm and Apache Giraph graph processing system.

UNIT IV

Information Diffusion in Social Networks: Strategic network formation: game theoretic models for network creation/ user behavior in social networks. Information diffusion in graphs: Cascading behavior, spreading, epidemics, heterogeneous social network mining, influence maximization, outbreak detection. Opinion analysis on social networks: Contagion, opinion formation, coordination and cooperation.

UNIT V

Dynamic Social Networks: Applications and Research Trends. Dynamic social networks, Link prediction, Social learning on networks. Special issues in Information and Biological networks. Important applications of social network mining related to the above topics. Research trends.

Text Books:

1 David Easley and Jon Kleinberg, Networks, crowds, and markets, Cambridge University Press, 2010.
2 Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, Mining of massive datasets, Cambridge University Press, 2014.

Suggested Reading:

1 John Schermerhorn, Jr. James G. Hunt and Richard N. Osborn “Organizational Behavior”, 10th Edition, Wiley India, Edition. 2009.

25MCC116

MACHINE LEARNING LAB USING PYTHON

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: AI & ML, Python programming

COURSE OBJECTIVES: This course aims to:

1. Provide students with practical experience in implementing AI and ML algorithms.
2. Enable students to train, validate and test ML models.

COURSE OUTCOMES : Upon completion of this course, students will be able to:

1. Understand basic components of library environment and installations and design heuristics to solve real world problems.
2. Implement problems using game search algorithms.
3. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Implement and evaluate various Machine Learning approaches.
5. Design and develop solutions to real world problems using ML techniques

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	2
CO2	2	3	2	1	1	2
CO3	3	3	2	1	1	2
CO4	2	3	3	2	2	2
CO5	2	3	3	2	3	3

List of Experiments:

1. Identification and Installation of python environment towards the artificial intelligence and machine learning, installing python modules/Packages scikitlearn, keras etc.
2. Implement A* algorithm on any problem.
3. Implement 8-queen problem using Heuristic search technique.
4. Implement Constraint Satisfaction problem using backtracking
5. Implement water Jug problem
6. Build linear regression model using gradient descent, least squares, polynomial, LASSO and RIDGE approaches also compare all the algorithms and draw a table for all the metrics.
7. Demonstration of Logistic Regression for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for dataset.
8. Demonstration of Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for dataset.
9. Build the decision tree classifier compare its performance with ensemble techniques like random forest, bagging, boosting and stacking Demonstrate it with different decision trees.
10. Demonstration of SVM and use for character recognition task.
11. Demonstration of Clustering algorithms - k-Means, Agglomerative and DBSCAN to classify for the standard datasets.

Text Books:

1. Russell, Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 2nd Ed., 2015.
2. Giuseppe Bonaccorso, “Machine Learning Algorithms”, 2nd Edition, Packt, 2018
3. Puneet Mathur, “Machine Learning Applications Using Python: Cases Studies from Healthcare, Retail, and Finance”, 1st Ed, Apress, 2019.

Suggested Reading:

1. Tom M. Mitchell, “Machine Learning”, McGraw Hill, 4th Ed., 2017.
2. Rich, Knight, Nair, “Artificial Intelligence”, Tata McGraw Hill, 3rd Ed., 2017.
3. Stephen Marsland, Machine Learning - An Algorithmic Perspective, 2nd Ed., CRC Press, 2014.
4. Saroj Kaushik, “Artificial Intelligence”, 1st Ed., Cengage Learning India, 2011.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs88/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs81/preview

25MCC117

SOFTWARE ENGINEERING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Basic knowledge of Programming and database.

COURSE OBJECTIVES : This course aims to

1. To understand and apply software development processes and requirement engineering techniques, including preparation of Software Requirement Specification (SRS) and user-oriented analysis.
2. To design and model software systems using UML diagrams, including structural and behavioral representations such as use case, class, sequence, collaboration, and activity diagrams.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Understand and apply software development phases, perform requirement engineering tasks and SRS
2. Perform user view analysis by constructing use case diagrams.
3. Develop structural models of a system using class diagrams.
4. Design behavioral models using sequence and collaboration diagrams.
5. Illustrate system workflows using activity diagrams.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	1	2	1
CO2	2	1	1	2	1	2
CO3	1	2	2	1	2	2
CO4	1	2	2	2	2	2
CO5	2	2	2	2	3	3

List of Experiments

1. Phases in software development project, overview, need, coverage of topics
2. To assign the requirement engineering tasks
3. To perform the system analysis: Requirement analysis, SRS
4. To perform the function-oriented diagram: DFD and Structured chart
5. To perform the user's view analysis: Use case diagram
6. To draw the structural view diagram: Class diagram
7. To draw the behavioral view diagram: Sequence diagram.
8. To draw the behavioral view diagram: Activity diagram
9. To perform various testing using the testing tool unit testing, integration testing

Sample Case Studies:

1. ATM application
2. Library management system
3. Railway reservation
4. E-Commerce System
5. Banking System

Recommended Textbooks & Resources

1. Software Engineering: R.S. Pressman, Software Engineering: A Practitioner's Approach. 9th Edition – 2023
2. The Unified Modeling Language Reference Manual, James Rumbaugh, Grady Booch, Ivar Jacobso, 2nd Edition 2010.

25MCC118

MINI PROJECT WITH SEMINAR

Instruction	3 Hours per week
Continuous Internal Evaluation	50 Marks
Credits	2.5

COURSE OBJECTIVES: This course aims to

1. To enable students to systematically design and develop a complete software/system solution.
2. To equip students with the ability to analyze results and effectively communicate their work.

COURSE OUTCOMES: At the end of the course, students will be able to:

1. Identify and analyze real-world problems and define appropriate solutions.
2. Design system architecture and select suitable tools/technologies.
3. Develop and implement a functional prototype/system.
4. Evaluate results and document findings in a structured report.
5. Present the project work effectively through seminars and viva voce.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	2
CO2	3	3	3	1	1	2
CO3	2	3	3	1	1	3
CO4	2	2	2	3	2	2
CO5	1	1	2	3	2	2

Problem Identification & Literature Survey : (2 Weeks)

- Identification of problem/domain selection
- Literature review and study of existing systems
- Problem formulation and objective definition
- Project planning and scheduling

System Design (3 Weeks)

- System architecture design
- Data flow diagrams / UML diagrams
- Database design (if applicable)
- Selection of tools, platforms, and technologies

Implementation (5 Weeks)

- Coding and development
- Integration of modules
- Testing methods (unit, integration, system testing)
- Debugging techniques

Results & Analysis (2 Weeks)

- Output generation and validation
- Performance analysis
- Comparison with existing systems
- Limitations and scope for future enhancement

Documentation & Seminar

- Report writing as per OU guidelines
- Preparation of PPT and demonstration
- Seminar presentation
- Viva voce

Guidelines for Mini Project

- The project may be carried out **individually or in a group (max 2 students)**.
- Project should be related to **current technologies** such as Web Development, Data Science, AI/ML, Mobile Applications, etc.
- Students must submit:
    - Project report (hard & soft copy)
    - Source code
    - Presentation slides
- Regular reviews should be conducted by the faculty guide.

Scheme of Evaluation

CIE (Max. Marks : 50)		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Mini-project Coordinator and Mentor	20	Review 1: Project Status / Progress
	5	Report
	5	Methodology
	10	Review 2: Slide Preparation & Presentation with demo
	5	Question and Answers
	5	Submission of Report

- Review 1 shall be scheduled from the 3rd week onwards since the commencement of the semester
- Review 2 shall be scheduled 2 weeks before the end of the semester.

25MCC119

INTERNSHIP

Instruction	5 weeks (135 Hours)
Continuous Internal Evaluation	100 Marks
Credits	3

Pre-Requisites : Software Engineering, a programming language

COURSE OBJECTIVES: This course aims to
1. Choose a relevant technical requirement in software industry
2. Implement the selected technical requirement as a project

COURSE OUTCOMES: After completion of this course, student will be able to
After completion of the course, students would be able to:
1. Conduct an independent feasibility study and survey on the selected technical domain.
2. Appreciate the industry point of view on the identified technical subject.
3. Analyze the requirement specifications.
4. Identify all the modules , interfaces , and implement the code
5. Present the technical documentation of the internship

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	3	3
CO2	3	3	3	1	2	1
CO3	2	3	3	1	1	3
CO4	2	2	2	3	2	2
CO5	1	1	1	3	2	2

The Curriculum includes the Internship for Students of four weeks' duration during summer vacation (at the end/after II Sem). The internship experience will augment outcome-based learning process and inculcate various project working attributes in a Student. Internships are educational and career development opportunities providing practical experience in a field or discipline.
The Students shall undertake the Internship during the summer vacation continuously for four weeks of duration in any Industry/ organization after seeking due approval from the Head of the Department. The award of credits for the Internship during summer shall be evidenced in the III Semester Grade Sheet.

Internship is compulsory for all the Students for the award of MCA degree and the guidelines for earning three (3 credits) by the student are furnished below:
Guidelines:
Procedure for granting permission to the student to carryout Internship by the Student, continuously for four (4) weeks duration from an organization during the summer vacation:
1. The Student needs to approach the Head of the Department with a request to carry out Internship, with the details of the Industry/Organization and the Department allocates one of the Faculty members as Guide.
2. The Guide will discuss with CEO/Director/HR/ Concerned person of that Industry/Organization on the following points:
- Duration of the Internship
- Nature of work to be carried out by the Student
- Facilities to be extended to the student in the Industry
- Requesting the industry Personnel to assign a guide or an in-charge to monitor the Student's work in the Industry
- Number of work hours to be spent by the Student
- Preparation of the documentation/report by the Student
- To apprise the Industry Personnel that the Internship carries a weightage of three (3) Credits.

3. If the Department recommends then the Student is permitted to carry out Internship in that particular

Industry/Organization, continuously for four (4) weeks during the summer vacation.
4. A copy of the confirmation / offer letter given by the Industry / Organization shall be maintained with the Department and with the Student.
5. Students on joining Internship at the concerned Industry/Organization should submit the copies of offer letter given by the Industry/Organization to the guide as well as Internship Coordinator in the department.
6. Students undergo Internship at the concerned Industry/Organization. The candidate should regularly submit his/her progress report to their respective Faculty guides. Guide/ Department level Technical Panel evaluate(s) the completion of internship at the end of Internship period.
7. Students will submit Internship report after completion of Internship.

Internship Report:
After completion of Internship, the Student should prepare a comprehensive report with regards to the learned, conduct and the implementation of internship. The Internship report should be signed by the Internship Supervisor (from Industry), Faculty Guide, and Head of the Department. The Internship report will be evaluated on the basis of following criteria:
1. Originality
2. Adequacy and purposeful write-up
3. Organization, format, charts/images/diagrams/models, language, style etc.
4. Variety and relevance of learning experience.
5. Practical applications, relationships with basic theory and concepts taught in the Course.

Monitoring and Evaluation of Internship:
The Internship of the Students will be evaluated in three stages:
1. Evaluation by Industry
2. Evaluation by Faculty Guide
3. Evaluation through Seminar Presentation/Viva-voce at the Institute.

Evaluation by Industry:
The Industry will evaluate the Students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary, skill test etc. for 20 marks.

Evaluation by Faculty Guide:
Two midterm evaluations shall be done by the Faculty Guide. One evaluation at the end of third (2nd) week of Internship and another at the end of 4th Week of Internship are to be carried out by the Faculty Guide. The midterm evaluation will be based on the work carried out by the Student in Industry/Organisation and also Attendance record, daily diary etc. For awarding marks for midterm evaluations the guide has to coordinate with the guide from industry. The midterm evaluations are to be carried out for a maximum of 30 marks.

Evaluation through Seminar Presentation/Viva-Voce at the Institute:
The student will give a seminar based on his Internship report, before an expert committee/panel constituted by the concerned department as per norms of the Institute. Committee examines the Students work and performance and the Marks (Maximum 50 marks) are to be awarded.
The evaluation will be based on the following criteria:
1. Quality of content presented (10 Marks)
2. Proper planning for presentation (10 Marks)
3. Effectiveness of presentation (10 Marks)
4. Depth of knowledge and skills (10 Marks)
5. Outcome of Internship (Publication, presentation in conference, project proposal etc.) (10 Marks)
Seminar presentation will enable sharing knowledge and experience amongst students and Faculty and build Effective communication skills and confidence in Students.
The Department sends the performance of the Student to the Controller of Examinations (CoE) for awarding Grade/Grade points towards earning of three (3) Credits by the Student for Internship.

25MCE113

CYBER SECURITY
(PROFESSIONAL ELECTIVE-IV)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer Networks

COURSE OBJECTIVES: This course aims to

1. To acquire knowledge of tools used in cybercrimes and laws governing cyberspace
2. To acquire knowledge of Cryptography and Network security and Cyber Forensics

COURSE OUTCOMES: After completion of the course , the students will be able to:

1. Identify different types of cybercrimes and analyze legal frame works to deal with these cybercrimes.
2. Apply Tools used in cybercrimes..
3. Infer the features of Cryptography and Network Security.
4. Interpret the Cyber Laws and use them accordingly.
5. Analyze the importance of digital evidence in prosecution.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	**1**	1	1	1
CO2	2	3	3	1	1	1
CO3	2	2	2	1	1	2
CO4	1	1	1	1	1	1
cos	1	1	2	1	1	1

UNIT-I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT-II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Botnets: The Fuel for Cybercrime Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms ,Trojan Horse , Steganography, DoS and DDoS attacks, attacks on wireless networks.

UNIT-III

Cryptography and Network Security: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, classical substitution ciphers: Caesar cipher, play fair cipher, block cipher: Festal cipher, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls-Types of Firewa11s, User Management, Kerberos 4.0, VPN Security Protocols: -security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT-IV

Cyberspace and the Law: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT-V

Cyber Forensics: Introduction,, Digital Forensics Science ,Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics

Textbooks:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt., Ltd, 2018
2. William Stallings, "Cryptography and Network Security Principals an Practice" 6th Edition, Pearson 2014
3. Suggested Readings:
4. Erdal Ozkaya, “Cyber security: The Beginner's Guide: A comprehensive guide to getting started in cyber security” Packt Publishing Limited, 27 May 2019
5. Aboul Ella Hassanien, &Mohamed Elhoseny “Cyber security and Secure Information System “ , Springer, 2019

25MCE114

QUANTUM COMPUTING
(PROFESSIONAL ELECTIVE-IV)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Knowledge of linear algebra and probability theory, quantum mechanics concepts and Programming proficiency (preferably Python).

COURSE OBJECTIVES: This course aims to

1. To develop a strong foundation in quantum computation by understanding quantum mechanics relevant to computing.
2. To analyse and implement quantum algorithms and circuit models.

COURSE OUTCOMES: After completion of the course , the students will be able to:

1. Explain the fundamental principles of computation models
2. Describe and analyze the mathematical framework of quantum mechanics.
3. Construct and simulate quantum circuits using basic and controlled quantum gates, and demonstrate applications.
4. Apply quantum computing concepts to design and analyze introductory quantum algorithms such as the Deutsch, Deutsch–Jozsa, and Simon's algorithms.
5. Evaluate advanced quantum algorithms like Quantum Phase Estimation, Quantum Fourier Transform, and Shor's Algorithm.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	1	1
CO2	3	2	1	1	1	1
CO3	2	1	1	1	1	1
CO4	3	1	1	1	1	2
CO5	2	1	1	1	1	1

1 - Slightly, 2 - Moderately, 3 – Substantially

UNIT – I

Introduction and background : Overview, Computers and the Strong Church–Turing Thesis , The Circuit Model of Computation , A Linear Algebra Formulation of the Circuit Model , Reversible Computation , A Preview of Quantum Physics , Quantum Physics and Computation. Linear algebra and the Dirac notation : The Dirac Notation and Hilbert Spaces , Dual Vectors , Operators, The Spectral Theorem , Functions of Operators , Tensor Products , The Schmidt Decomposition Theorem , Some Comments on the Dirac Notation.

UNIT – II

Qubits and the framework of Quantum mechanics : The State of a Quantum System , Time-Evolution of a Closed System , Composite Systems, Measurement, Mixed States and General Quantum Operations , Mixed States , Partial Trace, General Quantum Operations.

UNIT – III

A quantum model of computation: The Quantum Circuit Model , Quantum Gates ,Qubit Gates , Controlled-U Gates , Universal Sets of Quantum Gates , Efficiency of Approximating Unitary Transformations , Implementing Measurements with Quantum Circuits. Super dense coding and quantum teleportation: Super dense Coding, Quantum Teleportation , An Application of Quantum Teleportation.

UNIT – IV

Introductory quantum algorithms: Probabilistic Versus Quantum Algorithms , Phase Kick-Back , The Deutsch Algorithm , The Deutsch–Jozsa Algorithm , Simon's Algorithm.

UNIT – V

Algorithms with super polynomial speed-up: Quantum Phase Estimation and the Quantum Fourier Transform , Error Analysis for Estimating Arbitrary Phases , Periodic States , GCD, LCM, the Extended Euclidean Algorithm , Eigenvalue Estimation , Finding-Orders: The Order-Finding Problem , Some Mathematical Preliminaries , The Eigenvalue Estimation Approach to Order Finding ,Shor's Approach to Order Finding , Finding Discrete Logarithms , Hidden Subgroups , More on Quantum Fourier Transforms , Algorithm for the Finite Abelian Hidden Subgroup Problem , Related Algorithms and Techniques.

Textbooks:

1. An Introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, and Michele Mosca, Oxford University Press (2006)

Suggested Reading:

1. Quantum Information Science – Manenti R., Motta M., 1 st Edition, Oxford University Press (2023)
2. Elements of Quantum Computation and Quantum Communication, A. Pathak, Boca Raton, CRC Press (2015)

25MCE115

BLOCK CHAIN TECHNOLOGY

(PROFESSIONAL ELECTIVE - IV)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Structures, Data Communications and Computer Network,

COURSE OBJECTIVES: This course aims to

1. To understand the role, operations & the concepts of Blockchain technologies
2. To evaluate the various transaction flows of bitcoin operations & landscape concepts

COURSE OUTCOMES: After completion of this course, student will be able to

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

1. Identify the basic concepts , architecture , Ecosystem of Block chain
2. Understand the various operations & transactions of Block chain
3. Appreciate the security concepts , Encryption mechanisms & cyber security challenges
4. Evaluate the role, and process of Bit coin concepts
5. Analyze the role and functionalities of Block chain in modern-day scenario along with application.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	1	2	1
CO2	2	3	2	1	3	1
CO3	2	3	3	1	3	2
CO4	2	3	2	1	3	2
CO5	3	3	3	1	3	3

UNIT–I

Introduction to Distributed Ledger Technologies (DLT) Types of DLT: Block chain, Directed Acyclic Graph (DAG), Hashgraph, Holochain Block chain Architecture and Components Working of Block chain Key Characteristics of Block chain Public vs Private Blockchains Block chain Ecosystem

UNIT–II

Introduction to Cryptocurrencies and Bitcoin Operations, Transactions in Block chain, Crypto currency Exchanges, Smart Contracts: Concepts and Working, Ethereum: Architecture and Working, Hyper ledger Fabric: Architecture and Working, Comparison: Ethereum vs Hyperledger Fabric B2B Contracts and Decentralized Applications (DApps)

UNIT–III

Types of Cryptography: Symmetric, Asymmetric, Hash Functions, Cryptographic Schemes in Block chain, Public and Private Keys, Key Cybersecurity Features of Block chain, Common Cyberattacks: Phishing, DDoS, Sybil Attacks, Advantages and Limitations of Block chain in Cybersecurity

UNIT–IV

Introduction to Bit coin, Bit coin Transaction Lifecycle, Byzantine Generals Problem, Double-Spending Problem, Consensus Mechanisms Overview, Bitcoin Addresses: Vanity and Multi-Signature.

UNIT–V

Real-World Applications of Block chain, Supply Chain Management, E-Commerce Applications, Ledger Operations and Financial Use Cases, Block chain in IoT and Distributed Resources, Decentralized Streaming, Future Trends and Functional Mechanisms.

Text Books:

1 Rishab Garg " Block chain for Real world Application " John Wiley & Sons publications, 2023 – 1st Edition

2 Imran Bashir " Mastering Block chain", Pact publications – 2020 – 3rd Edition

Suggested Reading:

1 Andreas M. Antonopoulos "O'Reilly Publishing, 2017 - 2nd Edition.

25MCE116

NATURAL LANGUAGE PROCESSING
(PROFESSIONAL ELECTIVE – IV)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Artificial Intelligence, Machine learning and Compiler Design

COURSE OBJECTIVES: This course aims to

1. To learn the fundamentals of natural language processing and understand NLP's various text processing techniques.
2. To learn the various parsing techniques, RNN's and LSTM models, machine translation models.

COURSE OUTCOMES: After completion of this course, student will able to:

1. Analyze the various steps necessary for processing natural language.
2. Develop appropriate semantic necessary and sequence labeling techniques for a particular application
3. Apply appropriate neural network-based models for a contextual application.
4. Apply existing encoder-decoder models for Machine Translation techniques
5. Analyze the applications of NLP such as Chabot's, speech recognition and Machine translation models.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	2
CO2	3	3	3	1	2	2
CO3	3	3	3	1	2	2
CO4	3	3	3	1	2	2
CO5	3	3	3	1	2	2

UNIT - I

Regular Expressions, Text Normalization and Edit Distance: Regular Expressions, Simple Unix Tools for Word Tokenization, Word and Subword Tokenization, Word Normalization, Lemmatization and Stemming, Minimum Edit Distance, Language Modeling with N-Grams: N-Grams, Evaluating Language Models: Training and Test Sets, Smoothing, Interpolation, and Backoff

UNIT - II

Sequence Labeling for Part-of-Speech Tagging: English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Naive Bayes Classification and Sentiment: Naive Bayes Classifiers , Training the Naive Bayes Classifier, Worked example, Naive Bayes as a Language Model, Evaluation: Precision, Recall, F-measure, Test sets and Cross-validation.

UNIT - III

Context-Free Grammars and Constituency Parsing: Context-Free Grammars and Constituency Parsing Constituency, Context-Free Grammars, Treebanks, Grammar Equivalence and Normal Form, Ambiguity, CKY Parsing: A Dynamic Programming Approach, Dependency Parsing: Dependency Relations, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing Vector Semantics: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models.\

UNIT - IV

RNNs and LSTMS: Recurrent Neural Networks, RNNs as Language Models, RNNs for other NLP Task, Stacked and Bidirectional RNN Architectures, The LSTM, Lexicons for Sentiment and Affect: Dealing Emotion, Available Sentiment and Affect Lexicons, Creating Affect Lexicons by Human Labeling, Semi-supervised Induction of Affect Lexicons, Supervised Learning of Word Sentiment, Using Lexicons for Sentiment Recognition, and Using Lexicons for Affect Recognition.

UNIT - V

Machine Translation: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Decoding in MT: Beam Search, Dialog Systems and Chatbots: Properties of Human Conversation, Frame-Based Dialogue Systems, Dialogue Acts and Dialogue State, Chatbots, Dialogue System Design, Automatic Speech Recognition: The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture.

Text Books:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", (3rd ed.) ,2026.

Suggested Reading:

1. Christopher Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA, Second Printing, 1999.
2. Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP, 1st Edition, 2008.

25MCE117

HIGH PERFORMANCE COMPUTING
(PROFESSIONAL ELECTIVE – V)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer architecture and microprocessor, Operating systems, Data Structures, Design and analysis of algorithms.

COURSE OBJECTIVES: The objectives of this course are,

1. To learn modelling and problem solving using different types of parallel computing architectures.
2. To learn various paradigms in algorithm design for computationally intensive applications.

COURSE OUTCOMES:

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

1. Interpret different parallel computing architectures.
2. Design parallel algorithms and computing paradigms.
3. Analyse shared memory parallel programming with OpenMP.
4. Design algorithms suited for Multicore processor systems.
5. Develop hybrid parallelization skills.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	1
CO2	3	3	2	1	2	1
CO3	2	2	2	1	2	1
CO4	3	3	3	1	2	1
CO5	3	3	3	1	2	1

UNIT - I

Modern Processors: Stored-Program Computer Architecture, General-Purpose cache-based Microprocessor Architecture, Memory Hierarchies, Multicore processors, multithreaded processors, Vector processors. Basic optimization techniques for serial code: Scalar profiling, Common sense optimizations, Simple measures, large impact, the role of compilers.

UNIT - II

Parallel computers: Taxonomy of parallel computing paradigms, Shared-memory computers, Distributed memory computers, Hierarchical (hybrid) systems, Networks. Basics of parallelization: Why parallelize? Parallelism, Parallel scalability.

UNIT - III

Shared-memory parallel programming with OpenMP: Short Introduction to OpenMP, Efficient OpenMP programming: Profiling OpenMP programs, Performance pitfalls, Case study: OpenMP-parallel Jacobi algorithm.

UNIT - IV

Distributed-memory parallel programming with MPI: Message passing, A Short Introduction to MPI, Efficient MPI Programming: MPI performance tools, Communication parameters, Synchronization, serialization, contention, reducing communication overhead. Case study: Parallel sparse matrix-vector multiply.

UNIT - V

Hybrid parallelization with MPI and OpenMP: Basic MPI/OpenMP programming models, MPI taxonomy of thread interoperability, Hybrid decomposition and mapping, Potential benefits and drawbacks of hybrid programming

Text Books:

1. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

Suggested Reading:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Second Edition, Pearson Education,2007.
2. Michaek J. Quinn, "Parallel Computing: Theory and Practice", Second Edition, Tata McGraw-Hill Edition.

Online Resources:

1. https://www.educative.io/courses/learn-to-use-hpc-systems-and-supercomputers

25MCE118

SOFTWARE PROJECT MANAGEMENT
(PROFESSIONAL ELECTIVE –V)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Software Engineering.

COURSE OBJECTIVES: This course aims to

1. To understand software project management principles and select appropriate development models for effective project execution.
2. To apply design patterns, manage risks and timelines, and collaborate effectively with focus on communication and quality assurance.

COURSE OUTCOMES: After completion of the course, the students will be able to:

1. Gain basic knowledge of software project management principles.
2. Choose an appropriate project development model.
3. Implement design patterns in the software architecture.
4. Identify project risks, monitor and track project deadlines.
5. Work in a team environment and be aware of different models of communications and quality assurance

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	1	2	3
CO2	2	2	3	1	2	3
CO3	1	3	3	2	2	3
CO4	2	3	2	1	3	2
CO5	1	2	3	1	2	3

UNIT-I

Software Project Management: Introduction, Importance, Software Projects Vs Other types of Projects, Contract Management, Technical Project Management, Activities covered by SPM, Plans, Methods and Methodologies. Setting Objectives, Project Success and Failures, Management and Control. Project Evaluation and Programme Management: Project port polio management, Evaluation of Individual projects, Cost Benefit Evaluation Techniques, Risk Evaluation, Program Management, Managing the Resource with in the Program, Strategic Program Management, Aids to Program Management, Overview of Project Planning.

UNIT-II

Selection of an Appropriate Project Approach: Choosing the methodologies and technologies, Software process and process models. Software Effort Estimation: Problems with Over and Underestimates, Software Effort Estimation Techniques. Function Point Analysis. A Parametric Productive Model – COCOMO-2

Activity Planning: Objectives of Activity Planning, Schedules, Activities, Sequencing, Network Planning Models.

UNIT-III

Risk Management: Categories of Risk, A Frame work with Dealing with Risk, Evaluating Risk with the Schedule.

Resource Allocation: Nature of Resource, Identify Resource Requirements, Scheduling, Creating Critical path, Cost Schedules, Scheduling Sequence. Monitoring & Control: Creating Framework,

Collecting Data, Project Termination Review, Visualizing Progress, Cost Monitoring, Prioritizing Monitoring, Change Control, Software Configuration Management.

UNIT-IV

Managing Contracts: Types of Contracts, Stages in Contract Placement, Typical Terms of Contracts, Contract Management Acceptance. Managing People in Software Environments: Organizational behavior, selecting the Right person for the Job, Instruction in the best methods, Motivations, the Oldham-hackman Job characteristics model, Stress, Health and Safety, Some Ethical and Professional concerns. Working in Teams: Becoming a Team, Decision making, Organization and Team Structures, Coordination of dependencies, Communication genres, Communication plans, Leadership.

UNIT–V

Software Quality: The Place of Software Quality in Project planning, Quality Management Systems, Process Capability models, Software Reliability Quality plans, ISO: ISO – 9126, Product and Process Metrics, An Overview of PRINCE 2: Components of Prince 2.

Text Books:

1. Bob Hughes and Mike Cotterell, "Software Project Management", 6th Edition, Tata McGraw Hill, 2017.

Suggested Reading:

1. Walker Rayce, "Software Project Management: A Unified Framework", Addison Wesley, 1998. Watts S. Humphrey, "Managing Software Process", Addison – Wesley Pearson Education, 1998

25MCE119

EXPLAINABLE ARTIFICIAL INTELLIGENCE
(PROFESSIONAL ELECTIVE –V)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Artificial Intelligence.

COURSE OBJECTIVES: This course aims to

1. To develop a strong understanding of interpretable and explainable AI techniques.
2. To equip learners with the ability to apply and evaluate XAI methods across advanced domains.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Describe the machine learning application's context and why explainability might help.
2. Understand the concepts of model validation, evaluation, and performance visualization for both supervised and unsupervised learning.
3. Demonstrate post hoc explainability techniques through a self-chosen set of programming platforms.
4. Illustrate the results from Explainable deep learning techniques and suggest how it helps the problem context.
5. Describe the comprehension of challenges and future related to Explainable AI Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	1	1	2
CO2	2	3	2	1	2	2
CO3	2	3	3	1	2	2
CO4	3	3	2	1	1	2
CO5	2	3	3	1	2	3

UNIT-I

Introduction: Black-Box problem, Goals, Brief History, Purpose, Societal Impact, Types of Explanations, Tradeoffs, Taxonomy, Flowchart for Interpretable and Explainable Techniques Pre-model Interpretability and Explainability: Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering.

UNIT-II

Model Visualization Techniques and Traditional Interpretable Algorithms: Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms.

UNIT-III

Model Interpretability: Advances in Interpretable Machine Learning: Interpretable vs. Explainable Algorithms, Tools and Libraries, Ensemble-Based, Decision Tree-Based, Rule-Based Techniques, Scoring System Post-Hoc Interpretability and Explanations: Tools and Libraries, Visual Explanation, Feature Importance, Example-Based

UNIT-IV

Explainable Deep Learning: Applications, Tools and Libraries, Intrinsic, Perturbation, Gradient /

Backpropagation.

UNIT-V

Explainability: Time Series Forecasting, Natural Language Processing, and Computer Vision XAI: Challenges: Properties of Explanation, Categories of Explanation, Taxonomy of Explanation Evaluation XAI: Future: Formalization of Explanation Techniques and Evaluations, Adoption of Interpretable Techniques, Human-Machine Collaboration, Collective Intelligence from Multiple Disciplines, Responsible AI (RAI), XAI and Security, Causality and XAI.

Text Books:

1. Uday Kamath and John Liu "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer Cham, First Edition, 2021.

Suggested Reading:

1. Leonida Gianfagna and Antonio Di Cecco, "Explainable AI with Python", Springer International Publishing, First Edition, 2021.
2. Denis Rothman, "Hands-On Explainable AI (XAI) with Python", Packt Publishing, First Edition, 2020

Online Resources:

1. https://www.ibm.com/in-en/watson/explainable-ai
2. https://sites.google.com/view/explainable-ai-tutorial
3. https://cloud.google.com/explainable-ai

25MCE120

DEEP LEARNING
(PROFESSIONAL ELECTIVE –V)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basics of Mathematics and Machine Learning Fundamentals

COURSE OBJECTIVES: This course aims to

1. Describe the major differences between deep learning and other types of machine learning algorithms.
2. Explain the fundamental methods involved in deep learning, including the underlying optimization concepts (gradient descent and backpropagation), typical modules they consist of, and how they can be combined to solve real-world problems.

COURSE OUTCOMES: After completion of this course, student will be able to

1. Identify Suitable Neural Networks.
2. Optimize Deep learning Models
3. Apply Convolutional Neural Networks on real world problems
4. Apply Sequence Modeling
5. Formulate Deep Learning Research

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	2
CO2	3	3	2	1	1	2
CO3	2	3	3	1	2	2
CO4	2	3	3	1	2	2
CO5	2	3	2	2	2	3

UNIT - I

Deep Feedforward Networks: Example Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms. Regularization for Deep Learning Parameter Norm Penalties Norm Penalties as Constrained Optimization. Regularization and Under-Constrained Problems Dataset Augmentation Noise Robustness Semi-Supervised Learning, Multi-Task Learning. Early Stopping Parameter Tying and Parameter Sharing Sparse Representations. Bagging and Other Ensemble Methods Dropout Adversarial Training. Tangent Distance, Tangent Prop, and Manifold Tangent Classifier.

UNIT – II

Optimization for Training Deep Models: How Learning Differs from Pure Optimization Challenges in Neural Network Optimization, Basic Algorithms Parameter Initialization Strategies Algorithms with Adaptive Learning Rates Approximate Second-Order Methods Optimization Strategies and Meta-Algorithms.

UNIT - III

Convolutional Networks : The Convolution Operation, Motivation Pooling , Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs , Data Types , Efficient Convolution Algorithms. Random or Unsupervised Features. The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning.

UNIT – IV

Sequence Modeling: Recurrent and Recursive Nets Unfolding Computational Graphs. Recurrent Neural

Networks Bidirectional RNNs Encoder-Decoder Sequence-to-Sequence Architectures Deep Recurrent

Networks Recursive Neural Networks. The Challenge of Long-Term Dependencies. Echo State Networks. Leaky Units and Other Strategies for Multiple Time Scales the Long Short-Term Memory and Other Gated RNNs. Optimization for Long-Term Dependencies. Explicit Memory. Practical Methodology Performance Metrics. Default Baseline Models Determining Whether to Gather More Data. Selecting hyper parameters. Debugging Strategies. Example: Multi-Digit Number Recognition.

UNIT – V

Deep Learning Research: Linear Factor Models Probabilistic PCA and Factor Analysis Independent Component Analysis (ICA) Slow Feature Analysis, Sparse Coding. Manifold Interpretation of PCA. Auto encoders Under complete Autoencoders Regularized Autoencoders Representational Power, Layer Size and Depth Stochastic Encoders and Decoders Denoising Autoencoders Learning Manifolds with Autoencoders Contractive Autoencoders Predictive Sparse Decomposition Applications of Autoencoders Representation Learning Greedy Layer-Wise Unsupervised Pretraining Transfer Learning and Domain Adaptation Semi-Supervised Disentangling of Causal Factors Distributed Representation Exponential Gains from Depth Providing Clues to Discover Underlying Causes.

Text Books:

1. Ian Goodfellow, YoshuaBengio, “Aaron Courville, Deep Learning”, MIT Press, 2017.

Suggested Reading:

1. Nikhil Buduma, “Fundamentals of Deep Learning”, O’reilly Publications, 2017.
2. Valentino Zocca, GianmarioSpacagna, Daniel Slater, Peter Roelants, Python Deep Learning, PACKT, 2017.

25MEO201

INTELLECTUAL PROPERTY RIGHTS
(OPEN ELECTIVE)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: No formal pre-requisites

COURSE OBJECTIVES: This course aims to

1. Fundamental aspects of IP.
2. Salient features of IPR acts.
3. The methods of registrations of Intellectual property.
4. Awareness for innovation and its importance of protection.
5. The changes in IPR culture and techno-business aspects of IPR.

COURSE OUTCOMES: After the completion of this course, the student will be able upon completion of this course, the students are able to

1. Understand the evolution of IP, working of organizations at global level to protect and promote IP.
2. Familiarize with the patent filing process at national and international level.
3. Draw the logical conclusion of research, innovation and patent filing.
4. Compare different kinds of IP and their patenting system.
5. Understand the techno-legal-business angle of IP, infringement and enforcement mechanisms for protection.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	3	1	3
CO2	1	1	1	3	1	3
CO3	1	1	1	3	1	3
CO4	1	1	1	3	1	3
CO5	1	1	1	3	1	3

UNIT – I

Introduction: Definition of intellectual property, the need for intellectual property rights (IPR), kinds of intellectual property rights, IPR in India — genesis and development, IPR abroad, importance of WTO, TRIPS agreement, patent cooperation treaty, Berne and universal copyright conventions.

UNIT – II

Patents: Definition of patent, commercial significance, term of patent, patentable subject- matter, rights and obligations of patentee, searching of existing patents, drafting of patent, specification of patent, filing of a patent, the different layers of the patent system (national, regional and international options), compulsory licensing and licenses of rights, revocation of patents, differences between utility model and patent.

UNIT – III

Industrial Designs: Definition of designs, registration of design, rights and duties of proprietor of design, piracy of registered design. Trademarks: Meaning of trademarks, purpose of protecting trademarks, registration of trademarks, passingoff, assignment and licensing of trademarks, infringement of trademarks. Geographical indications: Definition, differences between GI and trademarks.

UNIT – IV

Copyright: Nature and scope of copy right, term of copyright, subject matter of copyright, rights conferred by copyright ,publication, broad casting, telecasting, computer program, database protection, assignment

and transmission of copyright, infringement of copy right trade secrets and know-how agreement.

UNIT – V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, enforcement measures, emerging issues in intellectual property protection, case studies of patents and IP Protection.

Unfair Competition: What is unfair competition, relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and SaritaD"Souza, "Indian Patents Law — Legal & Business Implications", Macmillan India Ltd., 2006.
2. B.L.Wadehra, "Lawrelating to Patents, Trade Marks", Copyright, Designs & Geographical Indications, Universal law Publishing Pvt Ltd., India, 2000.
3. P.Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, New Delhi, 2010.

Suggested Reading:

1. CronishW.R, "Intellectual Property Patents, Copyright, Trade Marks and Allied rights", Sweet & Maxwell,1993. 2. P.Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.

25MBO104

ORGANIZATIONAL BEHAVIOUR

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: The objectives of the Course are:

1. To familiarize the students with the basic understanding of individual behavior and explore issues of motivation, communication, leadership, power, politics and organizational change.
2. To provide a comprehensive, up-to-date, practical knowledge base that provides an engaging introduction and concepts of organizational behavior.
3. To enable the students to practically implement the Organizational Behavior principles and practice in real time situations in their careers and life.

COURSE OUTCOMES: After completion of this course students would be able to:

1. Analyze the Behavior, Perception and Personality of Individuals and Groups in Organizations in terms of the key factors that influence Organizational Behavior.
2. Assess the potential effects of Organizational-Level factors on Organizational Behavior.
3. Critically evaluate the potential effects of Motivating and Leading the Individuals in the Organization.
4. Analyze Organizational Behavioral issues in the context of Groups, Communication.
5. Develop strategies to deal with Power, Politics and Conflict issues at Workplace.

CO-PO Articulation Matrix

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	3	1	2	1	1
CO-2	1	3	1	1	2	1
CO-3	1	2	2	2	1	2
CO-4	1	2	1	3	2	1
CO-5	1	2	2	2	3	2

UNIT–I

Introduction: Organizational Behavior – Nature and Levels of Organizational Behavior – Individuals in Organization - Individual differences – Personality and Ability – The Big 5 Model of personality, MBTI – Organizationally Relevant Personality Traits. The nature of Perception – characteristics of the Perceiver, Target and Situation – Perceptual Problems, Attitude, Learning, IQ & EQ.

UNIT–II

Organization Structures and Culture: Concept of Organizational Structure– Types of Organizational Structure- Hierarchical organizational structure, Functional organizational structure, Horizontal organizational structure, Divisional organizational structures, Matrix organizational structure, Team-based organizational structure, Network organizational structure. Organizational culture and ethical behavior – Understanding the dimensions of Culture, what do cultures do? Creating and sustaining Culture, creating an Ethical Culture, managing Change.

UNIT–III

Motivation and Leadership: Motivation– Concept of Motivation- Theories of Motivation- Maslow's Need - Hierarchy Theory, Herzberg's Motivation - Hygiene Theory, McGregor's Theory X and Theory Y, ERG Theory, Vroom's Expectancy Theory, Equity Theory. Leadership – Concept of Leadership, Leaders vs. Managers-Theories of Leadership - The Great Man theory of Leadership,

Trait Theory of Leadership, Contingency Theory of Leadership, Situational Theory of Leadership,

Behavioral Theory of Leadership, Presentation on Indian Leaders, Leadership Issues in Current Business Environment.

UNIT–IV

Group Behaviour**:** Concept of Groups- Stages of Group Formation- Work groups and teams, Team Building, Team Dynamics, Tuckmann model, Functional and Dysfunctional Traits of Team Development. Communication - Interpersonal Communication, Organisational Communication, Roles, Frameworks and Barriers to Effective Communication, Transactional Analysis**.**

UNIT–V

Power, Politics, Conflict and Negotiations: Power, Politics, Conflict and Negotiations–Sources of Individual, Functional and Divisional Power. Organizational Politics. Conflict – Causes and Consequences – Pondy's model of Organizational Conflict – Conflict Resolution Strategies.

Text Books:

1. Robbins, S.P., Judge, T.A. & Vohra, N., Organizational Behavior, 19th Edition, Pearson, (2023)
2. Jennifer George & Gareth Jones, Understanding and Managing Organizational Behavior, (2021)
3. Colquitt, LePine & Wesson, Organizational Behavior: Improving Performance and Commitment in the Workplace, McGraw Hill, (2022)
4. Kreitner & Kinicki, Organizational Behavior, McGraw Hill, (2021)

Suggested Reading:

1. Griffin, R.W. & Moorhead, G., Organizational Behavior: Managing People and Organizations, Cengage, (2020)
2. Richard Greenberg, J., Behavior in Organizations, Pearson, (2019)
3. PeMiner, J.B., Organizational Behavior: Essential Theories of Motivation and Leadership, (2019)
4. Luthans, F., Organizational Behavior, McGraw Hill, (2021)
5. Harvard Business Review (HBR) Articles (Latest)

25MEO005

RESEARCH METHODOLOGIES AND INNOVATION
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Nil

COURSE OBJECTIVES: This course aims to

1. Make the students to formulate the research problem
2. Identify various sources for literature review and data collection.
3. Prepare the research design
4. Equip the students with good methods to analyze the collected data
5. Introduce students to the concepts of innovation

COURSE OUTCOMES: Upon completion of this course, the students will be able to

1. Define research problem
2. Review and assess the quality of literature from various sources.
3. Understand and develop various research designs.
4. Collect and analyze the data using statistical techniques.
5. Apply creative thinking and innovative skills.

CO-PO Articulation Matrix

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

UNIT – I

Research Methodology: Objectives, Motivation and Significance of Research, Types of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information Primary, Secondary and tertiary, Assessment of Quality of Journals and Articles.

Research writing: Format of the Research report, Writing a Synopsis, Dissertation, Research Proposal and Research Report

UNIT – III

Research Design: Meaning and Need of Research Design, Terminology used in Research Design, Features of a Good Research Design, Formulation of hypothesis, **O**perationalizing the research question, Different Research Designs – exploratory, descriptive, diagnostic and hypothesis testing research studies, Basic Principles of Experimental Design, Steps in Sample design

UNIT – IV

Data Collection and Analysis: Collection of primary data, Observation, Interview and Questionnaire methods, Secondary data, Measures of central tendency, Measures of dispersion, Measures of asymmetry, Important parametric testsz, t, F, ChiSquare, ANOVA significance.

UNIT – V

Innovation: Creativity, Innovation and its difference, Blocks for creativity and innovation, overcoming obstacles, Examples of innovation, being innovative, Steps for Innovation, right climate for innovation, Design led innovation, Gross root innovation, Frugal and flexible approach to innovation.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008

Suggested Reading:

1. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.

Online Resources:

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://archive.nptel.ac.in/courses/107/101/107101088/

25CEO102

DISASTER CONTROL AND RESPONSE
(OPEN ELECTIVE)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites : Nil

COURSE OBJECTIVES : This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks, and vulnerabilities including natural, climatic, and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

COURSE OUTCOMES: After completion of this course, student will be able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	1	1	1
CO2	1	1	1	1	1	1
CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	2	1	1	1	1

UNIT- I

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster-Natural and manmade; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non- structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radio logical Emergencies and case studies; Cases studies related to major power breakdowns, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi storied buildings.

UNIT- IV

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT- V

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government,community,local institutions, NGOs and other stake holders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Textbooks:

1. Pradeep Sahni," Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh," Handbook of Disaster Management: techniques &Guidelines", Rajat Publication, 2008.
3. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II"
4. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.

25MCC121

PROJECT WORK

Instruction	24 Hours per week
Continuous Internal Evaluation	100 Marks
Semester End Examination	100 Marks
Credits	12

Pre-requisites: Knowledge of Software development life cycle, able to identify a domain in demand in software industry & accordingly choose the appropriate technology to implement the identified problem

COURSE OBJECTIVES: This course aims to

1 To understand the phases involved in software development lifecycle.
2 To identify the appropriate software industrial demand and accordingly develop the software project.

COURSE OUTCOMES: After completion of the course the students would be able to:

1. Understand to capture project requirements from the client.
2. Analyze and implement software life cycle for the given requirements.
3. Design a real time solution for the given software requirement specifications.
4. Develop the solution for the chosen problem using the concepts and techniques in the curriculum.
5. Writes test cases and applies test case scenarios and record the entire development process.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	3	2	1
CO2	2	3	2	1	1	2
CO3	2	3	3	1	2	2
CO4	3	2	3	1	1	2
CO5	2	2	1	2	2	3

Assessment procedure for earning twelve (12) credits:

The student has to submit a hard copy of the Project report in a standard format which is prescribed by the department. Finally, the committee constituted by the department as per norms of Department/Institute evaluates the performance of the Student for a maximum of hundred (100) marks.

- The Student has to deliver Power- point presentation before the committee on the work which is carried out by the student during Project Work. Committee examines the student's Project work and the marks (Maximum 100 Marks) are to be awarded. The Department submits the performance of the student to the CoE for awarding Grade/Grade points towards earning twelve (12) credits by the student for Project Work.

Review-1 shall be scheduled from 3rd week onwards to monitor the progress of the project work.
Review-2 shall be scheduled after the first mid exam. For the award of CIE marks, students are judged by the DRC consisting of three (3) faculty members based on the work progress, relevance, quality, oral & written presentation, demonstration and report along with the supervisor's marks. The complete evaluation guidelines follows

The following is the rubrics followed for evaluation of Major Projects, Internal and External marks for IV semester.

Guidelines for awarding CIE (Max. Marks : 100)		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee (DRC)	15	Review 1
	15	Review 2
	10	Innovation / Research Related Work
	10	Analytical/ Programming/Experimentation Skills
	10	Quality of the work which may lead to Publication
Supervisor	10	Demonstration of Work / Results
	10	Regularity and Punctuality
	10	Work Progress
	10	Report Preparation

Guidelines for awarding SEE (Max. Marks : 100)		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Quality of the Project	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the Project • Innovation • Applications, • Live Research Projects, • Scope for further study, • Applications to Society
	20	Viva-voce