The Curriculum Book

Integrated Bachelor of Science (Hons. / Hons. with Research) - Master of Science

in

Computer Science (Artificial Intelligence and Data Science)

5 YEAR-PROGRAMME

(Scheme C)

Under Multiple Entry and Exit, Internship and

CBCS-LOCF as per NEP-2020

w.e.f. Session 2024-25

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY

HISAR-125001, HARYANA

(A+ NAAC Accredited State Govt. University)

Table 3: Curriculum and Credit Framework for Undergraduate Programmes (Single Major)

Semester	Discipline-Specific Courses (DSC)	Minor(MIC)/ Vocational (VOC)	Multidisciplinary courses (MDC)	Ability Enhancement courses (AEC)	Skill Enhancement Courses (SEC)/ Internship /Dissertation	Value-Added Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits DSC – A2 @ 4 credits	MIC1 @ 4 credits	MDC1 @ 3 credits	AEC1 @ 2 credits	SEC1@ 3 credits	VAC1 @ 2 credits	22
II	DSC – A3 @ 4 credits DSC – A4 @ 4 credits	MIC2 @ 4 credits	MDC2 @ 3 credits	AEC2 @ 2 credits	SEC2@ 3 credits	VAC2 @ 2 credits	22
Students exiting the programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject							
III	DSC – A3 @ 4 credits DSC – A4 @ 4 credits	MIC3 @ 4 credits	MDC3 @ 3 credits	AEC3 @ 2 credits	SEC3@ 3 credits	VAC3 @ 2 credits	22
IV	DSC – A5 @ 4 credits DSC – A6 @ 4 credits DSC – A7 @ 4 credits DSC – A8 @ 4 credits	MIC4(VOC)@ 4 credits	----------	AEC4 @ 2 credits	----------	VAC4 @ 2 credits	24
Students exiting the programme after fourth semester and securing 94 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC – A9 @ 4 credits DSC – A10 @ 4 credits DSC – A11 @ 4 credits DSC – A12 @ 4 credits	MIC5(VOC)@ 4 credits	----------	----------	Internship @ 4 credits#	----------	24
VI	DSC – A13 @ 4 credits DSC – A14 @ 4 credits DSC – A15 @ 4 credits DSC – A16 @ 4 credits	MIC6(VOC)@ 4 credits	----------	----------	SEC3@ 2 credits	----------	22
Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 136 credits.							
VII	DSC – H1 @ 4 credits DSC – H2 @ 4 credits DSC – H3 @ 4 credits DSC – H4 @ 4 credits DSC – H5 @ 4 credits	MIC7 @ 4 credits	----------	----------	----------	----------	24
VIII (4yr UG Hon.)	DSC – H6 @ 4 credits DSC – H7 @ 4 credits DSC – H8 @ 4 credits DSC – H9 @ 4 credits DSC – H10 @ 4 credits	MIC8 @ 4 credits	----------	----------	----------	----------	24
VIII (4yr UG Hon. with Research)	DSC – H6@ 4 credits DSC – H7@ 4 credits	MIC8 @ 4 credits	----------	----------	Research project/ Dissertation @ 12 credits	---------- TOTAL CREDITS	24 186

#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

SEMESTER I

Type of Course	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific Courses	24ADS0101T	Computer Fundamentals and C Programming	3	3	20	50	70	2.5
	24ADS0101P	C Programming Lab.	1	2	10	20	30	3
	24ADS0102T	Data Science	3	3	20	50	70	2.5
	24ADS0102P	Data Science Lab.	1	2	10	20	30	3
Minor Course/Vocational Course		To be opted from pool	4	4	30	70	100	3
Multidisciplinary Course		To be opted from pool	3	3	25	50	75	2.5
Ability Enhancement Course		To be opted from pool	2	2	15	35	50	2
Skill Enhancement Course		To be opted from pool	2	2	15	35	50	2
		To be opted from pool	1	2	10	15	25	3
Value Added Course		To be opted from pool	2	2	15	35	50	2
		TOTAL	**22**	**25**	**170**	**380**	**550**	

SEMESTER II

Type of Course	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific Courses	24ADS0201T	Data Structures	3	3	20	50	70	2.5
	24ADS0201P	Data Structures Lab.	1	2	10	20	30	3
	24ADS0202T	Artificial Intelligence	4	4	30	70	100	3
Minor Course/Vocational Course		To be opted from pool	4	4	30	70	100	3
Multidisciplinary Course		To be opted from pool	3	3	25	50	75	2.5
Ability Enhancement Course		To be opted from pool	2	2	15	35	50	2
Skill Enhancement Course		To be opted from pool	2	2	15	35	50	2
		To be opted from pool	1	2	10	15	25	3
Value Added Course		To be opted from pool	2	2	15	35	50	2
		TOTAL	**22**	**24**	**170**	**380**	**550**	

Note: Students who are interested to exit this programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject.

SEMESTER III

Type of Course	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific Courses	24ADS0301T	Database Management Systems	3	3	20	50	70	2.5
	24ADS0301P	Database Management Systems Lab.	1	2	10	20	30	3
	24ADS0302T	Object Oriented Programming using C++	3	3	20	50	70	2.5
	24ADS0302P	Object Oriented Programming using C++ Lab.	1	2	10	20	30	3
Minor Course/Vocational Course		To be opted from pool	4	4	30	70	100	3
Multidisciplinary Course		To be opted from pool	3	3	25	50	75	2.5
Ability Enhancement Course		To be opted from pool	2	2	15	35	50	2
Skill Enhancement Course		To be opted from pool	2	2	15	35	50	2
		To be opted from pool	1	2	10	15	25	3
Value Added Course		To be opted from pool	2	2	15	35	50	2
		TOTAL	**22**	**25**	**170**	**380**	**550**	

SEMESTER IV

Type of Course	Course Code	Nomenclature	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific courses	24ADS0401T	Data Analytics	3	3	20	50	70	2.5
	24ADS0401P	Data Analytics Lab.	1	2	10	20	30	3
	24ADS0402T	Multivariate Analysis	4	4	30	70	100	3
	24ADS0403T	Design and Analysis of Algorithms	3	3	20	50	70	2.5
	24ADS0403P	Design and Analysis of Algorithms Lab.	1	2	10	20	30	3
	24ADS0404T	Formal Language Theory	4	4	30	70	100	3
Vocational Course	.	To be opted from pool	2	2	15	35	50	2
		To be opted from pool	2	4	15	35	50	3
Ability Enhancement Course		To be opted from pool	2	2	15	35	50	2
Value Added Course		To be opted from pool	2	2	15	35	50	2
		TOTAL	**24**	**28**	**180**	**420**	**600**	

Note: Students who are interested to exit this programme after fourth semester and securing 94 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject.

Computer Fundamentals and C Programming

General Course Information

Course Code: 24ADS0101T **Credits:** 3 **Hours /Week:** 3 **Course Type**: Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This subject deals with computer fundamentals and the concepts of C programming language.

Course Outcomes:

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

CO1. Understand and explain fundamental computer concepts, including hardware, software, and memory organization.
CO2. Develop and execute basic programs in C language, utilizing control structures, loops, and functions to solve problems.
CO3. Effectively manage and manipulate data using arrays, strings, structures, and pointers in programming.
CO4. Apply modular and recursive programming techniques for building efficient and structured solutions.

Course Content

Unit I

Introduction to Computers: Introduction, Characteristics and limitations of computers, block diagram of computer, types of computers, uses of computers, computer generations. Input and output devices: Keyboard and mouse, inputting data in other ways, Types of Software: system software, Application software, commercial, open source, domain and freeware software, Memories: primary, secondary and cache memory. Windows basics: desktop, start menu, icons, Programming Languages: Machine language, assembly language, high level language, Flow charts.

Unit II

Introduction to C: Introduction, Structure of C Program, Writing the first C Program, File used in C Program, Compiling and Executing C Programs, Using Comments, Keywords, Identifiers, Basic Data Types in C, Variables, Constants, I/O Statements in C, Operators in C, Programming Examples, Type Conversion and Type Casting. Decision Control and Looping Statements: Introduction to Decision Control Statements, Conditional Branching Statements, Iterative Statements, Nested Loops, Arrays: Introduction, Declaration of Arrays, Accessing elements of the Array, Storing Values in Array, Calculating the length of the Array, Operations on Array, one dimensional array for inter-function communication, Two dimensional Arrays, Operations on Two Dimensional Arrays, Strings.

Unit III

Pointers : Understanding Computer Memory, Introduction to Pointers, declaring Pointer Variables, Pointer Expressions and Pointer Arithmetic, Null Pointers, Structure, Union, and Enumerated Data Types: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Unions, Enumerated Data Types ,Functions: Introduction, using functions, Function declaration/ prototype, Function definition, function call, return statement, Passing parameters, Scope of variables, Storage Classes, Recursive function.

Text and Reference Books:

1. E Balagurusamy, *Computing Fundamentals & C Programming*, TataMcGrawHill, SecondReprint, 2008.
2. P. K. Sinha and P. Sinha, *Foundations of Computing*, BPB publication, 6th edition, 2004.
3. Brian Kernighan and Dennis Ritchie, *The C Programming Language*, PHI, 1988.
4. Byron C Gottfried, *Theory and problem of programming with C*, TMH, 1996.
5. E Balaguruswamy, *Programming in ANSI C*, Tata McGraw-Hill, 2011.

C Programming Lab.

General Course Information

Course Code: 24ADS0101P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course will make the student understand and implement the C programming language for problem-solving techniques.

Course Outcomes:

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

- CO1. Write and execute C programs to implement basic programming concepts, including data types, operators, and expressions.
- CO2. Apply control structures and loops to solve problems that require decision-making and iterative processing.
- CO3. Work with arrays, strings, and pointers to perform data manipulation and storage efficiently.
- CO4. Develop modular programs using functions, passing parameters effectively, and implementing recursive solutions where applicable.

Practical Lab based on subject 24ADS0101T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Science

General Course Information

Course Code: 24ADS0102T **Credits:** 3 **Hours/ Week:** 3 **Course Type**: Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course introduces the basic terminology used in the life cycle of Data science project and Applications.

Program Outcomes:

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

- CO1. Understand core concepts of data science and explain its importance, applications, and challenges across various domains.
- CO2. Identify and handle various types of data and databases, including structured, unstructured, multimedia, and sensor data, addressing associated data challenges.
- CO3. Apply data science processes and techniques, including data wrangling, data munging, and exploratory data analysis, to prepare data for modeling.
- CO4. Utilize data science tools and platforms effectively to build applications, drawing on relevant programming languages and libraries.

Course Content

Unit I

Data science definition. Data science benefit our society, Data science relation to other domains, Data science applications area, Data science challenges, Data Science Classification, Data science tools and programming platforms for developing data science applications, Role of data scientist, Data science growing market.

Unit II

Various type of Data, Various types of databases and datasets such as structured, unstructured, graph, etc., Data related challenges. Multimedia data, social media data, biological data, sensor data, etc.

Different dataset with different challenges, Identifying Potential Data Sources, Data Wrangling, Data Munging.

Unit III

Data science Process: Prior Knowledge, Data Preparation, Modelling: Training and Testing Data set, Learning algorithms, Evaluation of model, Ensemble Modelling and Applications. Exploratory Data Analysis, Data Exploration: Objectives of Data Exploration, Datasets, Descriptive Statistics, Data visualization, Roadmap for Data Exploration, Supervised and Unsupervised learning.

Text and Reference Books:

1. Vijay Kotu, *Bala Deshpande, Data Science: Concepts and Practice*, Morgan Kaufmann 2ndedition, 2018.
2. Roger Peng, Elizabeth Matsui, *The Art of Data Science*, Lulu.com, 2016.
3. John D. Kelleher and Brendan Tierney, *Data Science*. The MIT Press, 2018.
4. Murtaza Haider, *Getting Started with Data Science: Making Sense of data with analytics*, IBMPress, 2015.
5. Field Cady, *The Data Science Handbook*, John Wiley & Sons, 2017.
6. Laura Igual and Santi Seguí, *Introduction to Data Science*, Springer International Publishing,2017.
7. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly Media, Inc. 2014.
8. Jure Leskovek, Anand Rajaraman and Jefrey Ullman., *Mining of Massive Datasets*, Cambridge University Press, 2019.

Data Science Lab.

General Course Information

Course Code: 24ADS0102P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course is about to familiarize oneself with Excel's Basic features and to gain skills on data visualization, data analysis and financial modeling using MS Excel.

Program Outcomes:

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

- CO1. Utilize Excel for data management and analysis, including data importing, cleaning, and organizing techniques.
- CO2. Perform descriptive statistics and exploratory data analysis using Excel functions and data visualization tools.
- CO3. Apply Excel's data analysis tools for predictive modeling, trend analysis, and decision-making support.
- CO4. Develop dashboards and reports to effectively communicate data insights and support data-driven decision-making.

Practical Lab based on subject 24ADS0102T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Structures

General Course Information

Course Code: 24ADS0201T **Credits:** 3 **Hours/Week:** 3 **Course Type**: Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

Data Structure is a core and an essential course for every graduate in Computer Science. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well.

Course Outcomes:

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

CO1. Understand and explain different data structures and abstract data types, including their properties, types, and applications in problem-solving.

CO2. Implement and perform operations on linear data structures like arrays, linked lists, stacks, and queues for efficient data management.

CO3. Apply tree and graph data structures to organize and manipulate data, including traversals and searching techniques.

CO4. Analyze algorithms for searching and sorting in terms of time and space complexity, understanding asymptotic notations.

Course Content

Unit I

Introduction to data structures and their types, Abstract data types, Linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists, Stack and Queue: Static and linked implementations, Operations and Applications

Unit II

Circular queues, Tress, Binary trees and related terminology, Tree traversals (Recursive), Threaded Binary Trees, BinarySearch Trees implementation and operations, Priority queues. Height Balanced or AVL trees and B trees. Graph definitions and related terminology.

Unit III

Single source shortest path, Hashing, Hash tables, hash function and collision resolution. Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

Text and Reference Books:

1. G.S. Baluja, *Data Structures Through C (a Practical Approach)*, Dhanpat Rai & Co.,2016.
2. Seymour Lipschutz, *Data Structures with C (Schaum's Outline Series)*, McGraw Hill Education,2017.
3. Ujjwal Mishra, *Data Structure Design*, Arihant Books,2023.
4. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
5. Langsam Yedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using C* and *C++*, PHI, 2009.
6. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms*, MITPress, 2009.
7. Robert L. Kruse, *Data Structure and Program Design in C*, Pearson Education India, 2007.

Data Structures Lab.

General Course Information

Course Code: 24ADS0201P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This lab course involves implementation of basic data structures and various operations on these data structures. The objective of the lab course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solving computational problem efficiently.

Course Outcomes:

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

CO1. Implement fundamental data structures such as arrays, linked lists, stacks, and queues using programming techniques.

CO2. Apply data structure operations (like insertion, deletion, traversal, and searching) to solve practical problems.

CO3. Develop tree and graph algorithms for tasks such as searching, sorting, and finding the shortest path.

CO4. Analyze and evaluate the efficiency of different algorithms in terms of time and space complexity through practical experimentation.

Practical Lab based on subject 24ADS0201T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Artificial Intelligence

General Course Information

Course Code: 24ADS0202T **Credits:** 4 **Hours/Week:** 4 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

Artificial Intelligence is a core and an essential course for every graduate in Computer Science. This course introduces the concepts of Artificial Intelligence and challenges inherent in building intelligent systems. It includes the role of knowledge representation in problem solving and how these are used in making intelligent machine.

Course Outcomes:

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

- CO1. Understand the fundamental concepts of Artificial Intelligence (AI), including its importance, techniques, and related fields.
- CO2. Apply search algorithms such as depth-first, breadth-first, and heuristic search to solve complex problems in AI.
- CO3. Demonstrate knowledge representation techniques and apply predicate logic to represent and reason about facts.
- CO4. Explain the principles of machine learning and expert systems, including various learning techniques and expert system design.

Course Content

Unit I

Overview of Artificial Intelligence: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Problems, Problem Space and search: Defining the problem as a state space search, Production system and its characteristics, Issue in the design of search problem.

Unit II

Depth first search, Breadth First Search Heuristic Search Technique: Generate and test, hill climbing, Best first search technique, A* algorithm, Game Playing: introduction to game playing, min-max and alpha-beta pruning algorithms.

Unit III

Knowledge representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation, Using Predicate Logic: Representing simple facts in logic.

Unit IV

Learning: Introduction learning, Rote learning, learning by taking advice, learning in problem solving, learning from example-induction, Explanation based learning.
Expert system: Introduction, Representing using domain specific knowledge, Expert system shells.

Text and Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial intelligence*, McGraw Hill Education, 2009.
2. Rajiv Chopra, *Artificial Intelligence (A Practical Approach)*, S Chand Publishing, 2012.
3. Stuart Russel and Peter Norvig, *Artificial intelligence: A modern Approach*, Pearson Education,2015.
4. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert System*, PearsonEducation.1st edition, 2007.
5. Deepak Khemani, *A first course in Artificial Intelligence*, McGraw Hill Education. 3rd edition,1st edition, 2013.
6. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex ProblemSolving*, Pearson Education, 5th edition, 2009

Database Management Systems

General Course Information

Course Code: 24ADS0301T **Credits:** 3 **Hours/Week:** 3 **Course Type**: Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course includes a detailed coverage of principles of database design and models. Students learn querying a database using SQL, normalization techniques, transaction processing etc.

Course Outcomes:

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

- CO1. Understand and explain the fundamentals of database systems, including database architecture, data models, and data independence.
- CO2. Design and databases model using the Entity-Relationship (ER) model and convert ER diagrams into relational tables.
- CO3. Apply relational database concepts and SQL to query and manipulate data effectively, understanding relational algebra, normalization, and integrity constraints.
- CO4. Implement concurrency control and transaction management techniques to maintain database integrity and recoverability in multi-user environments.

Course Content

Unit I

Overview: Overview of File Systems and Database Systems, Characteristics of the Database Approach, Advantages and Disadvantages of DBMS, DBMS architecture and various views of Data, Data Independence, Database languages, Data Models: Relational Database Model, Hierarchical Data Model, Network Data Model, Schemas and Instances.

E-R Model: Entity Types, Attributes & Keys, Relationships, Roles and Structural Constraints, E-R Diagrams, Reduction of an E-R Diagram to Tables.

Unit II

Relational Model and Query Language: Overview of Relational Database, Key Integrity Constraints, Relational Algebra, Relational Calculus, SQL fundamentals, Basic Operators, Missing information and NULL values. Relational Database Design: Overview of normalization, Database Anomalies, Candidate and Super Key, Functional Dependencies, Integrity Constraints, Decomposition, Normal forms: First, Second, Third Normal, Boyce Codd Normal Form, Multi-valued Functional Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Unit III

Concurrency Control Techniques: Overview of database Transactions, Transaction states, ACID properties of a Transaction, Transaction Recovery, Concurrency Control, Locking Techniques, Time-stamp ordering, Multi-version Techniques, Deadlock, Recovery Techniques in centralized DBMS.

Text and Reference Books:

1. Elmasri, R., and Navathe, S. B., *Fundamentals of Database Systems*, 3rd Edition, Addison Wesley, 2002.
2. Silberschatz, A., Korth, H. F., and Sudarshan, S., Database *System Concepts,* McGraw Hill, 2011.
3. Pannerselvam R., *Database Management Systems*, 2nd Edition, PHI Learning, 2011.
4. Desai, B. C., *An Introduction to Database System*, Galgotia Publication, 2010.
5. Leon, A., and Leon, M., *Database Management Systems*, Ist Edition, Vikas Publishing, 2009.
6. Mata-Toledo, R., Cushman, P., Sahoo, D., *Database Management Systems*, Schaums' Outline series, TMH, 2007.

Database Management Systems Lab.

General Course Information

Course Code: 24ADS0301P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This lab. course on DBMS involves a rigorous training on SQL programming. It provides a strong formal foundation in database concepts, technology and practice to the students to groom them into well-informed database application developers. The objective of the lab course is to develop proficiency in the execution of commands of the database design and query using Oracle

Course Outcomes:

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

- CO1. Create and manipulate database structures using SQL commands, including creating tables, inserting, updating, and deleting records.
- CO2. Execute complex SQL queries using various SQL constructs such as joins, subqueries, and aggregate functions to retrieve and analyze data effectively.
- CO3. Implement normalization techniques to design and refine database schemas, ensuring efficient data organization and integrity.
- CO4. Apply transaction management and concurrency control techniques to handle multiple user transactions, ensuring database consistency and recovery in simulated environments.

Practical Lab based on subject 24ADS0301T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Object Oriented Programming using C++

General Course Information

Course Code: 24ADS0302T **Credits:** 3 **Hours/Week:** 3 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

Objected Oriented Programming using C++ is an essential course for every graduate in Computer Science and Engineering. This course introduces the Object-Oriented concepts such as data encapsulation, data hiding, data abstraction, reusability, exception handling etc., and their implementation using C++.

Course Outcomes:

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

- CO1. Understand and apply the key concepts of Object-Oriented Programming (OOP) in C++, including classes, objects, inheritance, and polymorphism.
- CO2. Implement control structures and data types in C++ to develop programs that solve real-world problems, utilizing arrays, structures, and pointers.
- CO3. Create and manage functions in C++, including function overloading and inline functions, to enhance code reusability and efficiency.
- CO4. Utilize file handling techniques in C++ to read from and write to files, implementing sequential and random-access file operations.

Course Content

Unit I

Introduction to C++ - key concepts of Object-Oriented Programming, Advantages, Object Oriented Languages – I/O in C++ - C++ Declarations. Control Structures: - Decision Making and Statements: If ..else, break, continue, Loops in C++ : for, while, do-while, Array ,Structures, pointers , pointer and arrays. Pointer, New and Delete , References in C++.

Unit II

Functions in C++, inline functions, Constant functions, Function Overloading, Classes and Objects: Declaring Objects, Defining Member Function, Constructor and destructor, Static Member variables and functions, friend functions, Operator Overloading.

Unit III

Inheritance, Virtual Functions, Polymorphism, Abstract Classes, File and I/O Streams: Files and Streams, creating a Sequential Access File, Reading Data from a Sequential Access File, Updating Sequential Access File, Random Access File.

Text and Reference Books:

1. H. M. Deitel and P. J. Deitel, *C++ How To Program*, 6th Ed., Prentice Hall, 2008.
2. Robert Lafore, *Object-Oriented Programming in C++*, 3rd Ed., Sams Publishing, 2001.
3. D. Ravichandran, *Programming with C++*, 3rd Ed., T.M.H, 2011.
4. E. Balagurusamy, *Object oriented Programming with C++*, 6th Ed., Tata McGraw-Hill, 2013.
5. Horstmann, *Computing Concepts with C++ Essentials*, 3rd Ed., John Wiley, 2003.
6. Herbert Schildt , *The Complete Reference in C++*, 5th Ed., TMH, 2012.

Object Oriented Programming using C++ Lab.

General Course Information

Course Code: 24ADS0302P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course is to make the student to understand and implement the C++ programming language for problem solving techniques.

Course Outcomes:

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

- CO1. Design and develop C++ programs that utilize key object-oriented programming concepts such as classes, objects, inheritance, and polymorphism.
- CO2. Utilize C++ features effectively, including function overloading, operator overloading, templates, and exception handling, to create versatile and maintainable code.
- CO3. Perform file I/O operations to read from and write to files, including sequential and random access, ensuring proper management of file resources.
- CO4. Identify and resolve errors in C++ code using debugging techniques and tools, while also applying best practices for code optimization and memory management.

Practical Lab based on subject 24ADS0302T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Analytics

General Course Information

Course Code: 24ADS0401T **Credits:** 3 **Hours/Week:** 3 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

The course is about to review data to identify key insights and ways the data can be used to solve problems in the real time.

Course Outcomes:

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

CO1. Understand core concepts of data analytics, including data types, measurement scales, and the distinction between sample and population.

CO2. Effectively manipulate tabular data through sorting, filtering, and summarizing operations while performing exploratory data analysis to identify data distributions and handle outliers.

CO3. Visualize data insights through various data visualizations, including bar charts, histograms, scatter plots, and heatmaps, to effectively communicate findings.

CO4. Develop and evaluate predictive models using regression techniques and classification methods, evaluating their performance through metrics such as accuracy, sensitivity, and ROC curves.

Course Content

Unit I

Data analytics preliminaries: Introduction to data analytics, scales of measurements (Data types), Discriminating between sample and population. Quantile-Quantile plot.

Manipulating tabular data: Sorting, filtering cases, selecting variables, deriving new variables, grouping and summarizing data.

Exploratory data analysis: random and normally distributed variables, skewed normal distribution, z-score, detecting outliers in data, handling missing values.

Visualizing data through various plots and charts: bar charts, histogram, frequency polygon, density plots, scatter plots, box & whisker plots, heat and contour plots.

Unit II

Predictive modelling: what is predictive modelling, estimating a function, the trade-off between model accuracy and prediction accuracy and model interpretability, regression versus classification, measuring the quality of fit, The bias and variance trade- off.
Simple and multiple linear regression modelling: estimating the coefficients, assessing the accuracy of the coefficient estimates, assessing the accuracy of the model.

Unit III

Classification Modeling: The process of classification, decision tree, Bayesian, k-nearest neighbor, support vector machine classification models. Evaluating a classification model: confusion matrix, accuracy, sensitivity, specificity, f-measure, kappa statistics, ROC and area under curve. Accuracy and interpretability of classification models.
Evaluating the accuracy of a classifier: holdout or random sampling methods, cross-validation, bootstrap methods.

Text and Reference Books:

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, *An Introduction to Statistical Learning with Applications in R*, Springer, 2013.
2. W. N. Venables, D. M. Smith and the R core Team, *An introduction to R*, Notes on R: A Programming Environment for Data Analysis and Graphics, version 3.3.2, 2016.
3. Saroj Dahiya Ratnoo and Himmat Singh Ratnoo, *Essentials of R for Data Analytics*, Wiley, 021.
4. Hadley Wickham and Garrett Grolemund, *R for Data Science Import*, Tidy, Transform and model Data, O'Reilly, 2017.
5. Han, J., Kamber, M, Pei, J., *Data Mining Concepts and Techniques*, Third edition, Morgan Kaufmann, 2012.

Data Analytics Lab.

General Course Information

Course Code: 24ADS0401P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course will make the student understand and implement the data analytics concepts to analyze and work on the data.

Course Outcomes:

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

CO1. Manipulate and prepare datasets using various tools for data cleaning, transformation, and summarization.

CO2. Conduct exploratory data analysis on real-world datasets to uncover patterns and insights through statistical methods and visualizations.

CO3. Design and implement predictive models with linear regression and classification techniques, evaluating their performance using appropriate metrics.

CO4. Create effective visualizations to communicate data findings and model results, utilizing various plotting libraries and software tools.

Practical Lab based on subject 24ADS0401T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Multivariate Analysis

General Course Information

Course Code: 24ADS0402T **Credits:** 4 **Hours/Week:** 4 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

To familiarize the students with basics of Multivariate Analysis for complete examination of data by looking at all possible independent variables and their relationships to one another.

Course Outcomes:

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

- CO1. Understand vector and matrix algebra in multivariate analysis, including random vectors, expectation, and variance-covariance matrices.
- CO2. Apply statistical techniques for maximum likelihood estimation of mean vectors and dispersion matrices, and use sampling distributions for hypothesis testing related to mean vectors.
- CO3. Perform discriminant analysis using linear discriminant functions to classify multivariate normal populations and apply Wilks' λ criterion for significance assessment.
- CO4. Implement dimensionality reduction techniques like Principal Component Analysis (PCA) and Factor Analysis, and conduct clustering analyses such as K-means and hierarchical clustering to identify patterns in multivariate datasets.

Course Content

Unit I

Review of vector and matrix algebra and its applicability to multivariate analysis. Concept of random vector, its expectation and Variance-Covariance matrix. Marginal and joint distributions. Multivariate Normal distribution, marginal and conditional distributions, properties of normal distribution.

Unit II

Maximum likelihood estimates of mean vector and dispersion matrix (without proof). Sampling distributions of Hotelling's T^2 statistic and its relation with Mahalanobis's D^2 statistic. Tests of hypothesis about mean vector and difference of mean vectors. Wilks' λ criterion and its properties. Concepts of

discriminant analysis, computation of linear discriminant function, classification between k(≥2) multivariate normal populations based on LDF.

Unit III

Principal Component Analysis: extraction of Principal Components from data using correlation and covariance matrices as input, properties and interpretation of PCs, computational steps for PCA, criterion for retaining PCs. Factor Analysis and difference between Factor Analysis & PCA. Exploratory Factor Analysis.

Unit IV

Cluster Analysis, similarities and dissimilarities, Hierarchical clustering. Single, Complete and average linkage methods. K-means clustering and Ward's method. Canonical correlation and canonical variates.

Text and Reference Books:

1. Anderson TW., *An Introduction to Multivariate Statistical Analysis*, 2nd Ed. John Wiley1984.
2. Arnold SF., *The Theory of Linear Models and Multivariate Analysis,* John Wiley, 1981.
3. Buyan KC.,*Multivariate Analysis and its applications*, New Central Book Agency Pvt. Ltd. Publication, 2005.
4. Giri NC.,*Multivariate Statistical Inference*, Academic Press, 1977
5. Johnson RA & Wichern DW., *Applied Multivariate Statistical Analysis*. Prentice Hall, 1988.
6. Kshirsagar AM.,*Multivariate Analysis*. Marcel Dekker, 1972.
7. Morrison DF.,*Multivariate Statistical Methods*, McGraw Hill, 1976.
8. Muirhead RJ., *Aspects of Multivariate Statistical Theory*, John Wiley, 1982.
9. Rao CR., *Linear Statistical Inference and its Application,* 2nd Ed. John Wiley,1973.
10. Rencher AC.,*Methods of Multivariate Analysis*, 2nd Ed. John Wiley, 2002.
11. Srivastava MS & Khatri CG., *An Introduction to Multivariate Statistics*, North Holland, 1979.

Design and Analysis of Algorithms

General Course Information

Course Code: 24ADS0403T **Credits:** 3 **Hours/Week:** 3 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 70 (Internal: 20; External: 50)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This Course focus on effective and efficient design of algorithms. In this course various algorithm design techniques and their analysis is to be studied. After studying this course, a student is expected to apply better techniques for solving computational problems efficiently and prove it analytically.

Course Outcomes :
Upon completion of this course, students will be able to:

CO1. Understand the basic concepts of algorithms, including their definition, characteristics, and the significance of analyzing algorithm efficiency using asymptotic notations.
CO2. Implement and analyze sorting algorithms, including insertion sort, merge sort, quick sort, and heapsort, as well as understanding the divide-and-conquer methodology.
CO3. Apply greedy (such as the knapsack problem and minimum spanning trees) and dynamic programming (including matrix chain multiplication and longest common subsequence) techniques to solve optimization problems.
CO4. Utilize advanced backtracking and branch-and-bound techniques to address complex problems such as the 8-queens problem, graph coloring, and the traveling salesperson problem.

Course Content

Unit I

Algorithms, Insertion sort, analyzing algorithms, asymptotic notations
Divide and Conquer: General method, binary search, merge sort, quick sort and analysis of algorithms for these problems. Heapsort.

Unit II

Greedy Method: General method, knapsack problem, minimum spanning trees, single source paths and analysis of these problems.
Dynamic Programming: General method, matrix chain multiplication, longest common subsequence

Unit III

Back Tracking: General method, 8 queen's problem, graph colouring, Hamiltonian cycles, Analysis of these problems.
Branch and Bound: Method, O/I knapsack and traveling salesperson problem, NP-complete problems.

Text and Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronalde L. Rivest, Clifford Stein, *Introduction to Algorithms*, MIT press, 3rd Edition, 2009.
2. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekaran, *Fundamental of Computer Algorithms*, Galgotia Publication Pvt. Ltd., 1999.
3. S. Dasgupta, C. Papadimitriou, and U. Vazirani, *Algorithms*, McGraw-Hill Higher Education, 2006.

Design and Analysis of Algorithms Lab.

General Course Information

Course Code: 24ADS0403P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Discipline Specific course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 30 (Internal: 10; External: 20)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course will help the student to understand and implement the algorithms required to solve general problems.

Course Outcomes:

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

CO1. Implement and compare the efficiency of various sorting algorithms (e.g., insertion sort, merge sort, quick sort) and searching algorithms (e.g. linear search and binary search).

CO2. Design and implement greedy algorithms for optimization problems like the knapsack problem and minimum spanning trees, analyzing their correctness and efficiency.

CO3. Develop dynamic programming solutions for complex problems, such as matrix chain multiplication and longest common subsequence, optimizing recursive solutions through memorization and tabulation.

CO4. Apply backtracking and branch-and-bound strategies to combinatorial problems (e.g., the 8-queens problem, graph coloring, traveling salesperson problem).

Practical Lab based on subject 24ADS0403T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Formal Language Theory

General Course Information

Course Code: 24ADS0404T **Credits:** 4 **Hours/Week:** 4 **Course Type:** Discipline Specific course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

Formal Languages and Automata theory presents the theoretical aspects of computer science, which lay the foundation for students of Computer Science. The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine.

Course Outcomes:

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

- CO1. Understand and analyze finite automata, including both deterministic and non-deterministic types, and demonstrate the equivalence of DFA and NDFA through minimization techniques.
- CO2. Apply regular expressions and languages to define regular languages, convert between finite automata and regular expressions, and apply the Pumping Lemma to prove the non-regularity of specific languages.
- CO3. Differentiate between different types of grammars, including context-free and context-sensitive grammars, and perform transformations such as removal of useless symbols and conversion to Chomsky Normal Form (CNF).
- CO4. Design and analyze deterministic and non-deterministic Turing machines, understanding their role in computational theory and the Chomsky hierarchy of languages and grammars.

Course Content

Unit I

Finite Automata and Regular Expressions: Finite State Systems, Basic Definitions Non-Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA Finite automata. Minimization of finite Automata.

Unit II

Regular Sets and Regular Grammars: Equivalence of finite automata and Regular Expressions, Regular expression conversion and vice versa, The Pumping Lemma for Regular Sets, Applications of the pumping lemma.

Unit III

Grammars: Definition, Context free and Context sensitive grammar, Reduced forms, Removal of useless Symbols and unit production, Chomsky Normal Form (CNF), Pushdown Automata: Introduction to Pushdown Machines.

Unit IV

Turing Machines: Deterministic and Non-Deterministic Turing Machines, Design of T.M, Chomsky Hierarchies: Chomsky hierarchies of grammars.

Text and Reference Books:

1. Hopcroaft & O. D. Ullman, R Mothwani, *Introduction to automata theory, language & computations*, AW, 2001.
2. K. L. P. Mishra & N. Chandrasekaran, *Theory of Computer Sc. (Automata, Languages and computation)*, PHI, 2000.
3. Peter Linz, *Introduction to formal Languages & Automata*, Narosa, Publication, 2001.
4. Ramond Greenlaw and H. James Hoover, *Fundamentals of the Theory of Computation- Principles and Practice*, Harcourt India Pvt. Ltd., 1998.
5. H. R. Lewis & C. H. Papaditriou, *Elements of theory of Computation*, PHC, 1998.
6. John C. Martin, *Introduction to Languages and the Theory of Computation*, T.M.H., 2003.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Details of the courses offered by the department to students from other departments as per NEP-2020 are categorized as shown in the table below.

Type of Course	Semester	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Minor / Vocational Courses	1st	24MIC0117T	Multimedia and its Applications	2	2	15	35	50	2
	2nd	24MIC0217T	Logical Organization of Computers	2	2	15	35	50	2
	3rd	24MIC0317T	E-Commerce	4	4	30	70	100	3
	4th	24VOC0417T	Software Development	2 (Th)	2	15	35	50	2
		24VOC0417P	Software Development Lab.	2 (Pr)	4	15	35	50	3
Multidisciplinary Courses	1st	24MDC0103T	Introduction to Artificial Intelligence	3	3	25	50	75	2.5
	2nd	24MDC0203T	Introduction to Data Science	3	3	25	50	75	2.5
	3rd	24MDC0303T	Machine Learning	3	3	25	50	75	2.5
Skill Enhancement Courses	1st	24SEC0103T	R Programming	2 (Th)	2	15	35	50	2
		24SEC0103P	R Programming Lab.	1(Pr)	2	10	15	25	3
	2nd	24SEC0203T	Python Programming	2 (Th)	2	15	35	50	2
		24SEC0203P	Python Programming Lab.	1(Pr)	2	10	15	25	3
	3rd	24SEC0303T	Python Tools for Data Science	2 (Th)	2	15	35	50	2
		24SEC0303P	Python Tools for Data Science Lab.	1(Pr)	2	10	15	25	3
Value Added Courses	1st & 2nd	24VAC0114T	Cyber Security	2	2	15	35	50	2
	3rd & 4th	24VAC0314T	Cyber Laws and Ethics	2	2	15	35	50	2

Chairman

Multimedia and its Applications

General Course Information

Course Code: 24MIC0117T **Credits:** 2 **Hours /Week:** 2 **Course Type**: Minor / Vocational Courses **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

Multimedia is a minor course to understand the basic concepts of Multimedia and its applications. The objective of this course is to make students learn about the concepts of developing multimedia animations and to understand the technologies behind multimedia applications.

Course Outcomes:
Upon completion of this course, students will be able to:

- CO1. Understand and classify multimedia components, including hardware, software, audio, graphics, and video technologies.
- CO2. Work proficiently with multimedia audio and graphics by recording, editing, and manipulating digital files.
- CO3. Create basic animations and apply digital video editing techniques in multimedia projects.
- CO4. Develop multimedia projects through concept design, planning, and collaboration while exploring future trends in digital communication.

Course Contents

Unit I

Definition & Classification: Multimedia application -Multimedia Hardware - Multimedia software - CDROM - DVD. Multimedia Audio: Digital medium - Digital audio technology, sound cards - recording, editing. MP3: MIDI fundamentals - Working with MIDI - audio file formats - adding sound to Multimedia project. Multimedia Text: Text in Multimedia -Multimedia graphics: Coloring- digital imaging fundamentals - development and editing - file formats - scanning and digital photography

Unit II

Multimedia Animation: Computer animation fundamentals - Kinematics - morphing - animation s/w tools and techniques. Multimedia Video: How video works - broadcast video standards - digital video fundamentals – digital video production and editing techniques - file formats. Multimedia Project: stages of project - Multimedia skills - design concept - authoring - planning and costing –Multimedia Team. Multimedia-looking towards Future: Digital Communication and New Media, Interactive Television, Digital Broadcasting, Digital Radio, Multimedia Conferencing

T**ext and Reference Books:**

1. S. Gokul, *Multimedia Magic*, BPB Publications, 2nd Edition.
2. T. Vaughen, *Multimedia Making it Work*, TMH, 6th Edition.
3. K. Thakrar and P. K. Andleigh, *Multimedia System Design*, Prentice Hall India.
4. M. K. Pakhira, *Computer Graphics, Multimedia and Animation*, Prentice Hall India, 2nd Edition.
5. R. Parekh, *Principles of Multimedia*, Tata McGraw-Hill, 2007.

Logical Organization of Computers

General Course Information

Course Code: 24MIC0217T **Credits:** 2 **Hours /Week:** 2 **Course Type**: Minor / Vocational Courses **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course

"Logical Organization of Computer" is a course exploring the fundamental principles of digital systems. Covering topics such as information representation, binary logic, digital logic gates, and sequential circuits, students delve into the core components and operations of computers. Through understanding number systems, Boolean algebra, and circuit design, learners gain the skills to analyse, design, and optimize digital circuits. The course equips students with essential knowledge for various fields within computer science and engineering, providing a solid foundation for future studies and professional endeavours.

Course Outcomes

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

CO1. Understand various number systems and their conversions, explain fixed-point and floating-point representations, and utilize error detection and correction codes in digital systems.
CO2. Apply Boolean algebra and simplification techniques to design and analyze combinational and sequential logic circuits, including the use of Karnaugh maps for minimization.
CO3. Design and implement various combinational circuits (such as adders, subtractors, encoders, decoders, multiplexers, and comparators) and sequential circuits (like flip-flops, shift registers, and counters) using standard design methodologies.
CO4. Utilize digital design principles and practices to analyze, design, and implement digital systems, demonstrating the ability to apply theoretical concepts to practical applications.

Course Contents

Unit I

Information Representation: Number systems, Binary arithmetic, Fixed-point and Floating-point representation of numbers, BCD codes, Error detecting and correction codes, Character representation- ASCII, EBCDIC.
Digital Logic: Basic gates- AND, OR, NOT, Universal gates- NAND, NOR, Other gates – XOR, XNOR etc.,
Binary Logic: Boolean algebra, Boolean theorems, Boolean functions and Truth tables, Canonical and standard forms of boolean functions, De-Morgan's theorems, Simplification of boolean functions- Venn diagram, Karnaugh maps.

Unit II

Implementations of digital circuits, Combinational logic- characteristics, Design procedures, Analysis procedures. Combinational circuits: Half-Adder, Full- Adder, Half- Subtractor, Full-Subtractor, Encoders, Decoders, Multiplexers, De-multiplexers, Comparators, Code converters
Sequential Logic: Characteristics, Flip-Flops, Clocked RS, D type, JK, T type and Master- Slave flip-flops. State table, State diagram. Flip-flop excitation tables Shift registers: serial in parallel out and parallel in parallel out, Designing counters – Asynchronous and synchronous binary counters, Modulo-N counters and Up-Down counters

Text and Reference Books:

1. M. M. Mano, *Digital Logic and Computer Design*, Prentice Hall of India Pvt. Ltd.
2. V. Rajaraman and T. Radhakrishnan, *An Introduction to Digital Computer Design*, Prentice Hall of India Pvt. Ltd.
3. S. Goel, *Logical Organisation of Computer*, Natraj Publishing House.
4. C. Hamacher, Z. Vranesic, and S. Zaky, *Computer Organization*, 5th Edition, McGraw-Hill.

E-Commerce

General Course Information

Course Code: 24MIC0317T **Credits:** 4 **Hours /Week:** 4 **Course Type**: Minor / Vocational Courses **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 3 Hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:
This course deals with the introduction, different business models for e-Commerce, concept of mobile computing, different types of on-line business systems, techniques and implementation for electronics payment system, and legal considerations in e-Commerce.

Course Outcomes:
Upon completion of this course, students will be able to:

CO1. Grasp the fundamentals of e-commerce, including electronic markets, data interchange, and web-based architecture.
CO2. Analyze and apply various electronic payment systems, including EDI and secure transaction protocols, highlighting their significance in the digital economy.
CO3. Examine the influence of e-commerce on industries such as manufacturing, logistics, online publishing, and banking, while identifying related management challenges.
CO4. Evaluate the impact of intranets on corporate finance and customer asset management, focusing on financial systems and CRM strategies for improved business operations.

Course Contents

Unit I

E-commerce and its Technological Aspects Overview of developments in Information Technology and Defining E-Commerce: The scope of E-commerce, Electronic Market, Electronic Data Interchange, Internet Commerce, Benefits and limitations of E-Commerce, produce a generic framework for E-Commerce, Architectural framework of Electronic Commerce, Web based E-Commerce Architecture.

Unit II

Electronic Data Interchange: Benefits of EDI, EDI technology, EDI standards, EDI communications, EDI Implementation, EDI Agreements, EDI Security. Electronic Payment Systems, Need of Electronic Payment System: Study and examine the use of Electronic Payment system and the protocols used, Study Electronic Fund Transfer and secure electronic transaction protocol for credit card payment. Digital economy: Identify the methods of payments on the net – Electronic Cash, cheques and credit cards on the Internet.

Unit III

Intranets and Manufacturing: Integrated Logistics, Agile Manufacturing, Emerging Business Requirements, Manufacturing Information Systems, Intranet-based Manufacturing, Logistics Management. E-Commerce and Online Publishing: Why Online Publishing, Online Publishing approaches, Advertising and Online Publishing E-Commerce and Banking: Changing Dynamics in the Banking Industry, Home Banking Implementation Approaches, Management Issues in Online Banking.

Unit IV

Intranets and Corporate Finance: An Introduction, Financial Systems, Financial Intranets, Software Modules in Financial Information Systems, Human Resource Management Systems, Size/Structure of Financial Software Market.

Intranets and Customer Asset Management: Basics of Customer Asset Management, Online Sales Force, Online Customer Service and Support, Technology and Marketing Strategy.

Text and Reference Books:

1. R. Kalakota and A. B. Whinston, *Electronic Commerce: A Manager's Guide*, Pearson Education.
2. M. Greenstein and M. Vasarhelyi, *Electronic Commerce: Security, Risk Management and Control*, Tata McGraw-Hill.
3. P. T. Joseph, *E-Commerce: An Indian Perspective*, Prentice Hall of India.
4. E. Turban et al., *Electronic Commerce: A Managerial Perspective*, Pearson Education.
5. E. M. Awad, *Electronic Commerce*, Prentice-Hall of India Pvt. Ltd.
6. R. Kalakota and A. B. Whinston, *Electronic Commerce: A Manager's Guide*, Addison-Wesley.
7. E. Turban, J. Lee, D. King, and H. M. Chung, *Electronic Commerce: A Managerial Perspective*, Addison-Wesley.

Software Development

General Course Information

Course Code: 24VOC0417T **Credits:** 2 **Hours/Week:** 2 **Course Type:** Vocational Courses **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

This course will help the students to understand the systematic approach to requirement analysis, design, development, operations and maintenance of software systems. Besides this, it also guides students in developing the optimal software systems based on programming language and various software development tools used with connectivity to database.

Course Outcomes:

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

- CO1. Understand the foundations of software development, including the history, significance, and various software development methodologies such as Waterfall, Spiral, RAD, Agile, and Scrum.
- CO2. Demonstrate proficiency in using programming languages and tools, particularly Python, along with IDEs and version control systems like Git.
- CO3. Apply software design principles, including design patterns, architectural styles (e.g., MVC, Microservices), and UML diagrams, to develop robust software solutions.
- CO4. Utilize software development tools for database design and querying, front-end and back-end web development, testing practices, and project management techniques, including planning, scheduling, and risk management.

Course Content

Unit I

Foundations of Software Development: Overview, history, and significance of software development, Software Development Life Cycle (SDLC), Software Development Methodologies: Waterfall, Spiral, RAD, Agile, and Scrum, Programming Languages and Tools: Introduction to key programming language python including IDEs and version control (e.g., Git).Software Design and Architecture: design patterns, architectural styles (MVC, Microservices), and UML diagrams.

Unit II

Software Development Tools: Databases: Overview of SQL database, design principles, and querying techniques, Web Development: Introduction to front-end HTML, and back-end technologies, Testing: Concepts of unit, integration, and system testing, Project management: Project planning, scheduling, risk management, and resource allocation. Security: Principles of secure coding, common vulnerabilities, and security testing practices.

Text and Reference Books:

1. K. K. Aggarwal and Y. Singh, *Software Engineering*, 3rd Edition, New Age International Publishers Ltd., Reprint 2014.
2. R. S. Pressman, *Software Engineering: A Practitioners Approach*, 7th Edition, McGraw-Hill Education, 2014.
3. R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, 3rd Edition, Addison Wesley, 2002.
4. A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, McGraw-Hill, 2011.
5. Y. D. Liang, *Introduction to Programming Using Python*, Pearson, 2013.
6. R. Thareja, *Python Programming Using Problem Solving Approach*, Oxford Publications, 2017.
7. T. A. Powell, *HTML: The Complete Reference*, Tata McGraw-Hill, 2003.

Software Development Lab.

General Course Information

Course Code: 24VOC0417P **Credit:** 2 **Hours/Week:** 4 **Course Type:** Vocational Courses **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 50 (Internal: 15; External: 35)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course will provide a comprehensive understanding of basic programming, software development, and database management, preparing students for further studies or projects in software development. The objective of the lab course is to inculcate proficiency in students to design and develop market-based software applications.

Course Outcomes:

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

- CO1. Implement Agile and Scrum methodologies in practical projects, enhancing teamwork and collaboration skills.
- CO2. Develop proficiency in Python programming, including debugging and optimizing code, and using Git for version control.
- CO3. Design software solutions using appropriate design patterns and architectural styles for maintainability and scalability.
- CO4. Perform unit, integration, and system testing on software applications, documenting the process for quality assurance.

Practical Lab based on subject 24VOC0417T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Introduction to Artificial Intelligence

General Course Information

Course Code: 24MDC0103T **Credits:** 3 **Hours /Week:** 3 **Course Type**: Multidisciplinary Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This subject deals with the basic concepts of Artificial Intelligence.

Course Outcomes:

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

- CO1. Understand foundational AI concepts, including techniques and methodologies for problem-solving as state space searches.
- CO2. Demonstrate proficiency in search techniques, including depth-first, breadth-first, heuristic methods, and game-playing algorithms, analyzing their efficiency and applications.
- CO3. Apply logical reasoning to represent facts and infer conclusions using normal forms, clause forms, unification, and resolution techniques.
- CO4. Analyze and utilize knowledge representation methods such as semantic networks, frames, and scripts to organize and manipulate knowledge in AI applications.

Course Content

Unit I

Overview of Artificial Intelligence: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Problems, Problem Space and search: Defining the problem as a state space search, Production system and its characteristics, Issue in the design of search problem.

Unit II

Search Techniques: Depth first search, Breadth First Search, Heuristic Search Technique: Hill

climbing, best first search technique, A* algorithm, Searching of AND/ OR graph using AO* algorithm, Game Playing: AI and game playing, min-max algorithm, and Modified minimax with alpha-beta pruning.

Unit III

Logic: Propositional Logic, Predicate Logic, Representing facts in logic, Normal forms in logic, clause form, Unification, Resolution in predicate logic. Knowledge representation: Significance of Knowledge representation, Semantic Networks, Frames, Scripts, Conceptual dependency.

Text and Reference Books:

1. E. Rich, K. Knight, and S. B. Nair, *Artificial Intelligence*, McGraw Hill Education, 2009.
2. R. Chopra, *Artificial Intelligence (A Practical Approach)*, S Chand Publishing, 2012.
3. S. Russel and P. Norvig, *Artificial Intelligence: A Modern Approach*, Pearson Education, 2015.
4. D. W. Patterson, *Introduction to Artificial Intelligence and Expert System*, Pearson Education, 1st edition, 2007.
5. D. Khemani, *A First Course in Artificial Intelligence*, McGraw Hill Education, 3rd edition, 1st edition, 2013.
6. G. F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Pearson Education, 5th edition, 2009.

Introduction to Data Science

General Course Information

Course Code: 24MDC0203T **Credits:** 3 **Hours /Week:** 3 **Course Type**: Multidisciplinary Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This subject deals with the basic concepts of Data Science.

Course Outcomes:

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

CO1. Understand data science fundamentals, including data cleaning and preparation challenges.
CO2. Transform and preprocess data for effective analysis, distinguishing between structured and unstructured data.
CO3. Create and interpret various visualizations to communicate insights, utilizing advanced techniques like 3D graphics.
CO4. Analyze data science applications across sectors such as business, healthcare, and telecommunications, identifying relevant data-driven solutions.

Course Content

Unit I

Data Science-a Discipline, Landscape-Data to Data science, Data Growth-issues and challenges, data science process. foundations of data science. Messy data, Anomalies and artifacts in datasets. Cleaning data, Data Acquisition and Processing: introduction, Structured Vs. Unstructured data, data preprocessing techniques including data cleaning, selection, integration, transformation and reduction, data mining, interpretation.

Unit II

Representation of Data: Special types-acoustic, image, sensor and network data. General techniques for handling large data

Data Wrangling Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String manipulations – Regular Expressions , Data Aggregation and Group Operations Group By Mechanics – Data Aggregation – GroupWise Operations – Transformations – Pivot Tables – Cross Tabulations – Date and Time data types

Unit III

Data Modeling: Basics of Generative modeling and Predictive modeling. Charts histograms, scatter plots, time series plots etc. Graphs, 3D Visualization and Presentation, Applications of Data Science: Business, Insurance, Energy, Health care, Biotechnology, Manufacturing, Utilities, Telecommunication, Travel, Governance, Gaming, Pharmaceuticals, Geospatial analytics and modeling.

Text and Reference Books:

1. S. Ozdemir, *Principles of Data Science*, Packt Publishing, 2016.
2. J. Grus, *Data Science from Scratch*, O'Reilly, 2016.
3. F. Provost and T. Fawcett, *Data Science for Business*, O'Reilly, 2013.
4. R. D. Peng and E. Matsui, *The Art of Data Science*, Lean Publishing, 2015.
5. P. Bruce, A. Bruce, and P. Gedeck, *Practical Statistics for Data Scientists, 2e: 50+ Essential Concepts Using R and Python*, O′Reilly.

Machine Learning

General Course Information

Course Code: 24MDC0303T **Credits:** 3 **Hours /Week:** 3 **Course Type**: Multidisciplinary Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2.5 Hours	**Course Assessment Methods:** **Max. Marks: 75 (Internal: 25; External: 50)** The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This subject deals with the basic concepts of Machine Learning.

Course Outcomes:

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

- CO1. Understand well-posed learning problems and articulate essential components of designing learning systems, understanding well-posed learning problems, challenges, and inductive biases in machine learning tasks.
- CO2. Implement supervised learning algorithms such as linear regression, logistic regression, decision tree learning (ID3), and k-nearest neighbors, while evaluating model accuracy and coefficients.
- CO3. Analyze and implement unsupervised learning techniques, including clustering methods (k-means, k-medoids, DBSCAN) and artificial neural networks (perceptron, backpropagation), to extract patterns from unlabelled data.
- CO4. Apply Bayesian learning principles, including Bayes theorem and the Naïve Bayes classifier, for concept learning and maximum likelihood estimation in hypothesis formulation.

Course Content

Unit I

Introduction: Well posed learning problems, designing a learning system, Issues in machine learning, the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate-eliminations, Inductive bias..

Unit II

Supervised Learning: Introduction to linear regression, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic regression, basic decision tree learning (ID3) algorithm, Hypothesis space search in decision tree learning algorithm, Inductive bias in decision tree learning, Issues in decision tree learning, k-nearest neighbor learning.

Unit III

Unsupervised Learning: About clustering, type of data in clustering analysis, k-means and k-medoids, DBSCAN density-based clustering method, Performance analysis of clustering algorithms, Artificial Neural networks: Neural Network representations, Appropriate problems for neural network learning, back propagation algorithm.

Bayesian Learning: Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least-squared error hypotheses, Naïve Bayes Classifier.

Text and Reference Books:

1. T. M. Mitchell, *Machine Learning*, McGraw-Hill, 1997.
2. C. Bishop, *Pattern Recognition and Machine Learning*, Springer Verlag, 2006.
3. T. Hastie, R. Tibshirani, and J. Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, 2nd Edition, Springer, 2009.
4. J. Han and M. Kamber, *Data Mining Concepts and Techniques*, 3rd Edition, Elsevier, 2012.
5. S. Rajeshkaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications*, PHI, 2003.

R Programming

General Course Information

Course Code: 24SEC0103T **Credits:** 2 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

This course is to learn the fundamentals of R and covers how to use different functions in R for data analysis.

Course Outcomes:
Upon completion of this course, students will be able to:

CO1. Understand the significance of R as a programming language, and its advantages over others, and navigate R Studio effectively and manage packages, input, and output operations in R.
CO2. Manipulate R data types (vectors, lists, matrices, etc.) through operations like accessing, modifying, and merging data.
CO3. Implement decision-making constructs and looping mechanisms, including user-defined functions, to control program flow in R.
CO4. Load and analyze datasets in R, summarize data, perform statistical calculations, and manipulate text data for effective data analysis.

Course Content
Unit I

Introduction to R: What is R?, Why R? , Advantages of R over Other Programming Languages, R Studio: R command Prompt, R script file, Handling Packages in R: Installing a R Package, Input and Output: Entering Data from keyboard, Printing fewer digits or more digits, Special Values functions: NA, Inf and –inf, R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame,R Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables. R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators. R

Decision Making: if statement, if – else statement, if – else if statement, switch statement.R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.R Function: function definition, Built in functions: mean (), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values. R-Strings: Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower().

Unit II

R Vectors: Sequence vector, rep function, vector access, vector names, vector math, vector element sorting.R List: Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector.R Matrices: Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements
R Factors: creating factors, generating factor levels gl().Data Frames : Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions , Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir().R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File , R - Excel File – Reading the Excel file.

Text and Reference Books:

1. S. D. Ratnoo and H. S. Ratnoo, *Essentials of R for Data Analytics*, Wiley, January 2021.
2. S. Rakshit, *R Programming for Beginners*, McGraw Hill Education (India), 2017.
3. S. Acharya, *Data Analytics using R*, McGraw Hill Education (India), 2018.
4. A. de Vries and J. Meys, *R for Dummies*, 2nd Edition, John Wiley and Sons, Inc, 2015.

R Programming Lab.

General Course Information

Course Code: 24SEC0103P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (Internal: 10; External: 15)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course provides practical study related to the fundamentals of R and covers how to use different functions in R for data analysis.

Course Outcomes:

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

- CO1. Apply practical knowledge of R programming by writing and executing scripts that demonstrate data manipulation, statistical analysis, and visualization techniques.
- CO2. Effectively use R to clean and preprocess datasets, including handling missing values, transforming variables, and reshaping data structures for analysis.
- CO3. Create various data visualizations using R libraries like ggplot2 to communicate findings through graphical representations, including bar charts, histograms, scatter plots, and boxplots.
- CO4. Design and implement a mini-project that encompasses the entire data science process in R, from data acquisition and cleaning to analysis and visualization.

Practical Lab based on subject 24SEC0103T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Python Programming

General Course Information

Course Code: 24SEC0203T **Credits:** 2 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

Python is a popular open-source programming language used for both standalone programs and scripting applications in a wide variety of domains. It is free, portable, and powerful and is both relatively easy and remarkably fun to use. In today's era Python has found great applicability in machine learning, data analytics and many other data science applications. This is introductory course and covers most of the basic concepts required for basic python programming.

Course Outcomes:

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

- CO1. Understand the Python programming fundamentals, including data types, control structures, and functions, enabling the development of effective scripts and algorithms.
- CO2. Efficiently use and manipulate Python's built-in data structures, such as lists, tuples, and dictionaries, to solve programming problems and organize data effectively.
- CO3. Apply object-oriented programming principles in Python, including the creation of classes and objects, to design modular and reusable code.
- CO4. Manipulate strings and handle file operations in Python, showcasing the ability to process and manage text data and files effectively.

Course Content

Unit I

Introduction to Python, History of Python, Features of Python, Python Identifiers, Python Character Set, Keywords and Indentation, Comments, Command Line Arguments, Assignment Operator,

Operators and Expressions, print() Function, input() Function, eval() Function, Python Data Types: int, float, complex, Variables, Mutable vs Immutable variables, Decision Statements: Boolean Type, Boolean Operators, if statement, else statement, Nested Conditionals Statements, Multi-way Decision Statements (elif statement), Loop Control Statements: While loop, range() Function, For Loop, Nested Loops, Infinite Loop, Break Statement, Continue Statement, Pass Statement, Introduction to Strings, String Operations: Indexing and Slicing.

Unit II

Lists: Operations on List: Slicing, Inbuilt Functions for Lists, List Processing: Searching and Sorting, Tuples, Dictionaries: Need of Dictionary, Operations on Directories: Creation, Addition, Retrieving Values, Deletion; Tuples, operations on Tuples, Inbuilt Functions for Tuples, Python Functions, Inbuilt functions, Main function, User Defined functions, Defining and Calling Function, Parameter Passing, Actual and Formal Parameters, Default Parameters, Global and Local Variables, Recursion, Passing Functions as Data, Lamda Function, Modules, Importing Own Module. Python Object Oriented: Overview of OOP, Classes and objects, Accessing attributes, Built- In Class Attributes, Methods, Class and Instance Variables, Destroying Objects, Polymorphism,Class Inheritance.

Text and Reference Books:

1. Ashok Namdev Kamthane, *Programming and Problem Solving with Python*, Mc Graw Hill Education Publication, 2018.
2. Lutz, M., *Learning Python: Powerful Object-Oriented Programming*, O'Reilly Media, Inc.,2013.
3. John Guttag, *Introduction to Computation and Programming using Python*, Springer, Revisedand Expanded version (Referred by MIT), 2013.
4. Michael T Goodrich and Robertto. Thamassia, Micheal S Goldwasser, *Data Structures and Algorithms in Python*, Wiley, 2016.
5. Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
6. Reema Thareja, *Python Programming Using Problem Solving Approach*, Oxford Publications,2017.
7. R. Nageswara Rao, *Core Python Programming*, dreamtech Press, 2019.
8. Allen B. Downey *Think Python*, O'Reilly Media,2012.
9. Kenneth A. Lambert, *The Fundamentals of Python: First Programs*, Cengage Learning, 2011.

Python Programming Lab.

General Course Information

Course Code: 24SEC0203P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (Internal: 10; External: 15)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason, it is considered one of the best languages for beginners. Used for everything from web development to scientific computing Python is referred to as a general-purpose language by the greater programming community. The major objective of Python language is to make the students solve real word problem efficiently using python.

Course Outcomes:

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

- CO1. Implement Python Programming Concepts, including data types, control structures, and functions to solve programming problems.
- CO2. Design, code, and debug Python programs that utilize lists, tuples, dictionaries, and object-oriented programming principles to create structured and reusable code.
- CO3. Effectively use Python libraries and modules to enhance functionality and efficiency in coding, including importing and leveraging third-party libraries for specific tasks.
- CO4. Apply Python programming skills to perform data analysis and visualization using relevant libraries, enabling the interpretation and presentation of data effectively.

Practical Lab based on subject 24SEC0203T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Python Tools for Data Science

General Course Information

Course Code: 24SEC0303T **Credits:** 2 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

This course is about to familiarize the students with the python tools like NumPy, Pandas and other to solve the problems in data science effectively.

Course Outcomes:

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

- CO1. Utilize NumPy to create and manipulate multi-dimensional arrays, performing indexing, slicing, and mathematical operations for data analysis.
- CO2. Apply Pandas data structures (Series and DataFrames) to manage structured data, conduct data cleaning, and handle missing values for effective preprocessing.
- CO3. Design informative visualizations using Matplotlib to communicate data insights through various plots and charts.
- CO4. Implement techniques to read from and write to multiple data formats (CSV, Excel, HTML, JSON, etc.) and databases for seamless data integration across applications.

Course Content

Unit I

NumPy: History , Ndarray, Create an Array , Types of Data , dtype Option , Intrinsic Creation of an Array , Basic Operations, Arithmetic Operators , Matrix Product , Increment and Decrement Operators , Universal Functions (ufunc) , Aggregate Functions ,Indexing, Slicing, and Iterating , Indexing ,Slicing , Iterating an Array , Conditions and Boolean Arrays , Shape Manipulation , Array Manipulation , Joining Arrays, Splitting Arrays , General Concepts- Copies or Views of Objects ,Vectorization ,Broadcasting ,Structured Arrays , Reading and Writing Array Data on Files , Loading and Saving Data in Binary Files , Reading Files with Tabular Data

Introduction to pandas Data Structures , Series , DataFrame , Index Objects , Other Functionalities on Indexes , Reindexing , Dropping , Arithmetic and Data Alignment , Operations Between Data Structures , Flexible Arithmetic Methods , Operations Between DataFrame and Series , Function Application and Mapping , Functions by Element , Functions by Row or Column ,Statistics Functions ,

Sorting and Ranking , Correlation and Covariance , “Not a Number” Data , Assigning a NaN Value , Filtering Out NaN Values , Filling in NaN Occurrences , Hierarchical Indexing and Leveling , Reordering and Sorting Levels , Summary Statistic by Level .

Unit II

pandas: Reading and Writing Data, I/O API Tools ,CSV and Textual Files , Reading Data in CSV or Text Files, Using RegExp to Parse TXT Files , Reading TXT Files Into Parts ,Writing Data in CSV , Reading and Writing HTML Files , Writing Data in HTML , Reading Data from an HTML File , Reading Data from XML, Reading and Writing Data on Microsoft Excel Files , JSON Data , Format HDF5 , Pickle—Python Object Serialization , Serialize a Python Object with cPickle , Pickling with pandas , Interacting with Databases , Loading and Writing Data with SQLite3 ,Loading and Writing Data with PostgreSQL , Reading and Writing Data with a NoSQL Database: MongoDB

pandas in Depth: Data Manipulation, Data Preparation, Merging, Concatenating, Combining, Pivoting, Removing , Data Transformation , Removing Duplicates , Mapping , Discretization and Binning , Detecting and Filtering Outliers , Permutation , Random Sampling , Data Aggregation , GroupBy , Hierarchical Grouping , Group Iteration , Chain of Transformations , Functions on Groups , Advanced Data Aggregation

Data Visualization with matplotlib : matplotlib Library , matplotlib Architecture , Backend Layer , Artist Layer , Scripting Layer (pyplot) , pylab and pyplot , pyplot -A Simple Interactive Chart , Plotting Window , Set the Properties of the Plot , matplotlib and NumPy , Using the kwargs , Working with Multiple Figures and Axes , Handling Date Values , Chart Typology ,Line Charts ,Line Charts with pandas , Histograms , Bar Charts , Horizontal Bar Charts , Multiserial Bar Charts , Multiseries Bar Charts with pandas Dataframe , Multiseries Stacked Bar Charts , Stacked Bar Charts with a pandas Dataframe , Other Bar Chart Representations , Pie Charts , Pie Charts with a pandas Dataframe , Advanced Charts , Contour Plots , Polar Charts , 3D Surfaces , Scatter Plots in 3D , Bar Charts in 3D , Multi-Panel Plots , Grids of Subplots

Text and Reference Books:

1. Fabio Nelli, S. B., *Python Data Analytics: With Pandas, NumPy, and Matplotlib*, Apress; 2nd ed. edition (28 September 2018).
2. Oswald Campesato , S., *Python Tools for Data Scientists*, Mercury Learning and Information, 2022.

Python Tools for Data Science Lab.

General Course Information

Course Code: 24SEC0303P **Credit:** 1 **Hours/Week:** 2 **Course Type:** Skill Enhancement Course **Category:** Practical **Mode:** Lab Practice and Assignments	**Course Assessment Methods:** **Total Marks: 25 (Internal: 10; External: 15)** The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course is to make the student to implement the Python Tools for Data Science like NumPy, Pandas and more for problem solving techniques.

Course Outcomes:

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

- CO1. Perform data manipulation using NumPy and Pandas, including array and DataFrame creation, data transformation, and aggregation.
- CO2. Analyze real-world datasets with Python, applying statistical methods to extract insights and identify trends.
- CO3. Create and customize visualizations using Matplotlib, including line plots, bar charts, histograms, and scatter plots.
- CO4. Read and write data in various formats (CSV, Excel, JSON, etc.) and utilize databases for effective data integration in Python.

Practical Lab based on subject 24SEC0303T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Cyber Security

General Course Information

Course Code: 24VAC0114T **Credits:** 2 **Hours /Week:** 2 **Course Type**: Value Added Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

This subject deals with the computer fundamentals and the concepts Cyber Security.

Course Outcomes:

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

- CO1. Understand the architecture of cyberspace and key concepts of cyber security, including cyber-crime classification and legal frameworks.
- CO2. Identify and mitigate challenges related to cyber security threats such as malware, ransomware, and social engineering.
- CO3. Assess security risks in social media and digital payment systems, implementing best practices for safe usage.
- CO4. Apply security measures for endpoint devices, including password policies and data backup, in line with cyber security best practices.

Course Content

Unit I

Defining Cyberspace and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet infrastructure for data transfer and governance, Internet society, Concept of cyber security, Issues and challenges of cyber security, Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India.

Unit II

Introduction to Social networks and media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Best practices for the use of Social media.

Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Text and Reference Books:

1. R. C. Mishra, *Cyber Crime Impact in the New Millennium*, Author Press, 2010.
2. S. Belapure and N. Godbole, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India Pvt. Ltd., 1st Edition, 2011.
3. H. A. Oliver, *Security in the Digital Age: Social Media Security Threats and Vulnerabilities*, Create Space Independent Publishing Platform, Pearson, 13th November, 2001.
4. E. M. Awad, *Electronic Commerce*, Prentice Hall of India Pvt. Ltd.
5. K. Kumar, *Cyber Laws: Intellectual Property & E-Commerce Security*, Dominant Publishers.
6. E. Cole, R. Krutz, and J. W. Conley, *Network Security Bible*, 2nd Edition, Wiley India Pvt. Ltd.
7. E. Maiwald, *Fundamentals of Network Security*, McGraw-Hill.

Cyber Laws and Ethics

General Course Information

Course Code: 24VAC0314T **Credits:** 2 **Hours /Week:** 2 **Course Type**: Value Added Course **Category:** Theory **Mode:** Lectures (L) **Examination Duration:** 2 Hours	**Course Assessment Methods:** **Max. Marks: 50 (Internal: 15; External: 35)** The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. **Note:** The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:
Tis course is about to underlines the ethical concerns and cyber security issues surrounding information security policies, procedures, systems, and teams.

Course Outcomes :
Upon completion of this course, students will be able to:

- CO1. Understand the various forms of cybercrime, including forgery, hacking, and software piracy, and explain the methods criminals use to execute attacks.
- CO2. Analyze security challenges posed by mobile and wireless devices, including the specific threats and cryptographic measures needed to protect them.
- CO3. Identify tools and techniques used in cybercrime, such as proxy servers, phishing, and SQL injection, and discuss their implications for cybersecurity.
- CO4. Evaluate the legal frameworks governing cybercrime in India, including the IT Act, and understand the ethical considerations surrounding cybersecurity practices and case studies.

Course Content

Unit I

Introduction of Cybercrime: What is cybercrime?, Forgery, Hacking, Software Piracy, Computer Network intrusion Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cybers talking. Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.

Unit II

Tools and Methods used in Cyber crime: Proxy servers, panword checking, Random checking, Trojan

Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow. Phishing & Identity Theft: Phishing methods, ID Theft; Online identity method. Cybercrime & Cyber security: Legal aspects, Indian laws, IT act, Public key certificate Ethics: Legal Developments, Cyber security in Society, Security in cyber laws case studies, General law and Cyber Law-a Swift Analysis.

Text and Reference Books:

1. N. Godbole and S. Belapure, *Cyber Security*, Wiley India.
2. M. F. Grady and F. Parisi, *The Law and Economics of Cyber Security*, Cambridge University Press, 2006.