Dr. Gazal

Gurugram University, Gurugram

GENERAL COURSE STRUCTURE AND CREDIT DISTRIBUTION

M. Sc. (Computer Science)

Scheme of Studies/Examination w.e.f. 2024-25

Scheme PG A1: Postgraduate Programmes (Course work only)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A01	Database Management Systems	241/CS/CC101	3	0	2	3	0	1	4	25	50	5	20	100
CC-A02	Operating System and Shell Programming	241/CS/CC102	3	0	2	3	0	1	4	25	50	5	20	100
CC-A03	Data Structures and Algorithms using Python	241/CS/CC103	3	0	2	3	0	1	4	25	50	5	20	100
Discipline Specific Elective Courses														
DSE-01	Data Communication and Computer Networks Or Theory of Computation	241/CS/DS101 241/CS/DS102	2	1	0	2	1	0	3	25	50	-	-	75
Multidisciplinary Course(s)														
MDC-01	One from Pool	241/CS/MD101	2	1	-	2	1	-	3	25	50	-	-	75
Ability Enhancement Course(s)														
AEC-01	One from Pool	241/CS/AE101	2	-	-	2	-	-	2	15	35	-	-	50
Value-added Course(s)														
VAC-01	One from Pool	241/CS/VA101	2	-	-	2	-	-	2	15	35	-	-	50
Total Credits									**22**					**550**

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A04	Cryptography and Network Security	241/CS/CC201	3	0	2	3	0	1	4	25	50	5	20	100
CC-A05	Programming in Java	241/CS/CC202	3	0	2	3	0	1	4	25	50	5	20	100
CC-A06	Analysis and Design of Algorithms	241/CS/CC203	3	0	2	3	0	1	4	25	50	5	20	100
Discipline Specific Elective Courses														
DSE-02	Discrete mathematics and Statistics Or Mobile Computing	241/CS/DS201 241/CS/DS202	2	1	0	2	1	0	3	25	50	-	-	75
Multidisciplinary Course(s)														
MDC-02	One from Pool	241/CS/MD201	2	1	-	2	1	-	3	25	50	-	-	75
Ability Enhancement Course(s)														

AEC-02	One from Pool	241/CS/AE201	2	-	-	2	-	-	2	15	35	-	-	50
Skill Enhancement Course(s)														
SEC-01	One from Pool	241/CS/SE201	2	-	-	2	-	-	2	15	35	-	-	50
Total Credits									**22**					**550**

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A07	Artificial Intelligence	241/CS/CC301	3	0	2	3	0	1	4	25	50	5	20	100
CC-A08	Software Engineering & Testing	241/CS/CC302	3	0	2	3	0	1	4	25	50	5	20	100
CC-A09	R programming	241/CS/CC303	3	0	2	3	0	1	4	25	50	5	20	100
Discipline Specific Elective Courses														
DSE-03	Block Chain Technology Or Soft Computing Techniques using Neural Networks	241/CS/DS301 241/CS/DS302	2	1	0	2	1	0	3	25	50	-	-	75
Multidisciplinary Course(s)														
MDC-03	One from Pool	241/CS/MD301	2	1	-	2	1	-	3	25	50	-	-	75
Skill Enhancement Course(s)														
SEC-02	One from Pool	241/CS/SE301	2	-	-	2	-	-	2	15	35	-	-	50
Value-added Course(s)														
VAC-02	One from Pool	241/CS/VA301	2	-	-	2	-	-	2	15	35	-	-	50
Seminar														
Seminar	Seminar	241/CS/SM301	2	-	-	2	-	-	2	50	-	-	-	50
Internship/Field Activity#														
	Internship/Field Activity	241/CS/INT301	-	-	8	-	-	4	4	100	-	-	-	100
Total Credits									**28**					**700**

#Four credits of internship earned by a student during summer internship after 2nd semester will be counted in 3rd semester of a student who pursue 2 year PG Programme without taking exit option.

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A10	Machine Learning using Python	241/CS/CC401	3	0	2	3	0	1	4	25	50	5	20	100
CC-A11	Big Data Analytics	241/CS/CC402	3	0	2	3	0	1	4	25	50	5	20	100
Discipline Specific Elective Courses														
DSE-04	Optimization Techniques Or Cloud Computing and IoT	241/CS/DS401 241/CS/DS402	2	1	0	2	1	0	3	25	50	-	-	75
Multidisciplinary Course(s)														
MDC-04	One from Pool	241/CS/MD401	2	1	-	2	1	-	3	25	50	-	-	75
Ability Enhancement Course(s)														
AEC-03	One from Pool	241/CS/AE401	2	-	-	2	-	-	2	15	35	-	-	50

Community Engagement/Field Work/Survey/Seminar/Project/Training														
	Project/Training	241/CS/PR401	-	-	12	-	-	6	6	-	-	-	-	150
Total Credits									**22**					**550**

SEMESTER 3

ARTIFICIAL INTELLIGENCE

Semester	3			
Course code	CC-A07			
Category	Core Course(s)			
Course title	Artificial Intelligence			
Course ID	241/CS/CC301			
Scheme and Credits	L	T	P	Credits
	3	0	2	4
Theory Internal	25 marks			
Theory External	50 marks			
Practical Internal	5 marks			
Practical External	20 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand the Basics about Artificial Intelligence and Expert Systems.

CO2: Understand the Programming Logics in Artificial Intelligence.

CO3: Understand Various search methods in Artificial Intelligence.

CO4: Understand the Image processing and analysis.

CO5: Understand the latest developments in Knowledge systems and Tools.

UNIT-I

INTRODUCTION: History, Definition of AI, Emulation of human cognitive process, knowledge search trade off, stored knowledge, semantic nets. An abstract view of modelling, elementary knowledge. Computational logic, analysis of compound statements using simple logic connectives, predicate logic, knowledge organization and manipulation, knowledge acquisition.

UNIT-II

PROGRAMMING AND LOGICS IN ARTIFICIAL INTELLIGENCE: LISP and other programming languages- introduction to LISP, syntax and numerical function, LISP and PROLOG distinction, input output and local variables, Interaction and recursion, property list and arrays alternative languages, formalized symbolic logics properties of WFRS, non-deductive inference methods. Inconsistencies and uncertainties Truth maintenance systems, default reasoning and closed world assumption, Model and temporary logic.

UNIT-III

SEARCH METHODS AND KNOWLEDGE REPRESENTATION: Fuzzy logic concepts, Introduction to Fuzzy logic with examples, probabilistic reasoning, Bayesian probabilistic inference, Dempstor Shafer theory, possible world representation, AdHoc methods. Structure knowledge: Graph, frames and related structures, Object oriented representation- object classes, message and methods, simulation examples using OOPS programs, OOP languages. Search and control strategies - Concepts, search problems, uniformed or Blined search, searching AND – OR graphs.

UNIT-IV

KNOWLEDGE ORGANISATION AND COMMUNICATION IN EXPERT SYSTEMS Matching techniques, Need for matching, matching problem, partial matching, Fuzzy matching, RETE matching algorithm. Knowledge organization- Indexing and retrieval techniques, integration of knowledge in memory organization systems, Perception, communication and Expert systems. Overview of Linguistics, Basic passim techniques, semantic analysis and representation structures, natural language generation and system.

BOOKS:

1. Russel (Stuart), 'Artificial Intelligence- Modern approach, Pearson Education series in AI', 3rd Edition, 2009.

2. Dan W Patterson, 'Introduction to Artificial intelligence and Expert systems', Prentice Hall of India Pvt. Ltd, 2001

3. Eugene Charniak, Drew Mc Dermot, 'Introduction to Artificial intelligence', Addison Wesley Longman Inc.,2009

4. George. F, William. A. Stubblefield, 'Artificial intelligence and the design of expert systems', The Benjamin Cummins Publishing Co., Inc 2nd Edition, 1992.

5. Robert J Schalkoff, 'Artificial intelligence An Engineering Approach', McGraw Hill International Edition, 1990

ARTIFICIAL INTELLIGENCE LAB

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Study of Prolog and LISP.
2. Write simple fact for the statements using PROLOG.
3. Write predicates for simple problems such as conversion of temperature from Fahrenheit to centigrade or vice-versa, calculating area of rectangle, square and circle, etc.
4. Write program to solve the Monkey Banana problem.
5. Write program in Prolog for medical diagnosis.
6. Write program to solve mathematical problem such as calculate factorial, generate Fibonacci series, etc.
7. Write program to solve 4-Queen / 8-Queen problem.
8. Write program to solve traveling salesman problem.
9. Write program to solve water jug problem.
10. Write program to solve tic-tac-toe problem.
11. Write program to implement uninformed searching algorithms.
12. Write program to implement informed searching algorithms.

SOFTWARE ENGINEERING & TESTING

Semester	3			
Course code	CC-A08			
Category	Core Course(s)			
Course title	Software Engineering & Testing			
Course ID	241/CS/CC302			
Scheme and Credits	L	T	P	Credits
	3	0	1	4
Theory Internal	25 marks			
Theory External	50 marks			
Practical Internal	5 marks			
Practical External	20 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand Software Engineering Fundamentals, Analyze Software Development Models and Processes and Recognize and Address Software Development Challenges

CO2: elicit, analyze, and document software requirements effectively and utilise tools to produce comprehensive SRS document.

CO3: proficiency in designing software systems using both structured and object-oriented methodologies, understand software reliability metrics and specifications.

CO4: understand the characteristics of software maintenance, methods for maintaining software systems, and the importance of maintainability and implement strategies to minimize side effects during maintenance activities.

CO5: apply various testing strategies and employ debugging effectively.

UNIT-I

Introduction to Software Engineering, System Engineering Vs Software Engineering, Software Evolution, Software Characteristics, Components, Crisis–Problems and Causes, Software Feasibility, Software Process Models – VModel, Waterfall, Iterative Enhancement, Incremental, RAD, Prototyping, Spiral, Concurrent Development, Rational Unified Process & AGILE. Challenges in Software Engineering

UNIT-II

Software Project Management – Planning, Scope Management, Cost Estimation – LOC, Function Point Analysis & COCOMO, Putnam Resource Allocation Model, Project Scheduling & Resource Management Gantt-Chart, PERT & CPM, Histogram, Team Building and Organization Charts, Project Monitoring & Risk Management, Software Configuration Management, Software Quality Assurance, Project Monitoring& Techniques. Software Requirement Analysis - Structured Analysis, Object Oriented Analysis and Data Modelling, Software Requirement Specification, DFDs, Data Dictionaries, Decision Trees, Decision Tables & Structured English, ER Diagrams.

UNIT-III

Design and Implementation of Software – Basic Fundamentals, Design Methodology (Structured and Object Oriented), Design Approaches, User Interface Designing Tools & Techniques, Design Complexity, Monitoring and Control, Coding, Halstead's Software Science, McCabe's Cyclomatic Complexity Software Reliability: Metric and Specification, Fault Avoidance and Tolerance, Exception Handling, Defensive Programming, Component Based Development.

UNIT-IV

Software Testing – Fundamentals, Validation & Verification, White-Box and Black-Box Testing Techniques (Control Flow, Data Flow, Loop, Mutation, Load, Stress, Performance, Boundary Value, Equivalence Class, Decision Table, Cause Effect Graph Testing) Testing Strategies: Unit, Integration, Validation and System Testing, Alpha & Beta Testing, Debugging, Static Testing Strategies. Software & Maintenance: Maintenance Characteristics, Maintainability, Maintenance Tasks and Side Effects.

BOOKS:

1. Gill, Nasib Singh. Software Engineering. Khanna Book Publishing Co. (P) Ltd., New Delhi.
2. Pressman S. Roger, Software Engineering, Tata McGraw Hill.
3. Jalote Pankaj, An Integrated Approach to Software Engineering, Narosa Publ. House.
4. K. K. Aggarwal, Yogesh Singh, Software Engineering, New Age International.
5. Sommerville, Software Engineering, Pearson Education.
6. Fairley Richard, Software Engineering Concepts, Tata Mc-Graw Hill Ed.
7. Rajib Mall, Fundamentals of Software Engineering, PHI Learning.

SOFTWARE ENGINEERING & TESTING LAB

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function-oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. To perform the user's view analysis for the suggested system: Use case diagram.
5. To draw the structural view diagram for the system: Class diagram, object diagram.
6. To draw the behavioral view diagram: State-chart diagram, Activity diagram
7. To perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
8. To perform the implementation view diagram: Component diagram for the system.
9. To perform the environmental view diagram: Deployment diagram for the system.
10. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
11. Perform Estimation of effort using FP Estimation for chosen system.
12. To prepare time line chart/Gantt Chart/PERT Chart for selected software project.

R PROGRAMMING

Semester	3			
Course code	CC-A09			
Category	Core Course(s)			
Course title	R Programming			
Course ID	241/CS/CC303			
Scheme and Credits	L	T	P	Credits
	3	0	1	4
Theory Internal	25 marks			
Theory External	50 marks			
Practical Internal	5 marks			
Practical External	20 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1. understand Fundamentals of R.

CO2. use different functions in R, read data into R, accessing R packages, writing, R functions, debugging, and organizing data using R functions.

CO3. Cover the Basics of statistical data analysis with examples.

CO4. apply mathematical and statistical operations data structures in R

CO5. explain critical R programming language concepts such as control structures and recursion.

CO6. Demonstrate and implement basic R programming framework and data structures.

UNIT - I

BASICS OF R

Introduction to R: What is R? – Why R? – Advantages of R over Other Programming

Languages- R Studio: R command Prompt, R script file, comments.

Handling Packages in R: Installing a R Package, Few commands to get started: installed. packages(), package. Description(), help(), find. Package(), library() - Input and Output – Entering Data from keyboard.

R - Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame.

R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables

UNIT - II

OPERATORS AND LOOPS

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-inn 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.

UNIT - III

DATA TYPES IN R

R – Strings: Manipulating Text in Data: substr(), strsplit(), paste(), grep(). toupper(), tolower().

R – Vectors: Sequence vector, rep function, vector access, vector names, vector math, vector recycling, 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().

R - 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()

UNIT - IV

DATA VISUALIZATION

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.

Data Visualization through various plots and charts: bar charts, histogram, frequency polygon, density plots, scatter plots, box & whisker plots, heat and contour plots, plotting the above graphs in R, plotting with package ggplot2.

BOOKS:

1. Cotton, R., Learning R: a step by step function guide to data analysis. 1st edition. O'reilly Media Inc.
2. Gardener, M.(2017). Beginning R: The statistical programming language, WILEY.
3. Lawrence, M., & Verzani, J. (2016). Programming Graphical User Interfaces in R. CRC press. (ebook)

R PROGRAMMING LAB

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Write a R program to take input from the user (name and age) and display the values.
2. Write a R program to get the details of the objects in memory.
3. Creating a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
4. Creating a simple bar plot of five subjects' marks.
5. Get the unique elements of a string and unique numbers of vectors
6. Appending value to a given empty vector
7. Multiplying two vectors of integer type and length 3
8. Find the sum, mean and product of a vector, ignoring elements like NA and NaN.
9. To create three vectors a,b,c with 3 integers. Combine three vectors to become a 3*3 matrix where each column represents a vector. Print the content of the matrix
10. Program to create a matrix from a list of given vectors.

SEMESTER 4

MACHINE LEARNING USING PYTHON

Semester	4			
Course code	CC-A10			
Category	Core Course(s)			
Course title	Machine Learning Using Python			
Course ID	241/CS/CC401			
Scheme and Credits	L	T	P	Credits
	3	0	1	4
Theory Internal	25 marks			
Theory External	50 marks			
Practical Internal	5 marks			
Practical External	20 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Define machine learning and its types, Compare machine learning approaches with traditional programming methods.

CO2: Demonstrate proficiency in Python syntax, including data types and control structures.

CO3: Apply NumPy and Pandas skills to preprocess and prepare data for machine learning models effectively.

CO4: Apply dimensionality reduction techniques (PCA, t-SNE) to reduce the complexity of high-dimensional data and visualize relationships.

CO5: Gain insights into advanced machine learning topics such as Support Vector Machines (SVM) for classification and regression tasks, and delve into neural networks and deep learning basics using TensorFlow/Keras for building and training models

UNIT I

Introduction to Machine Learning and Python Basics: Overview of machine learning:

definitions, types (supervised, unsupervised, reinforcement learning), and applications. Comparison of machine learning with traditional programming approaches.

Python Basics for Machine Learning: Introduction to Python programming language: syntax, data types (numeric, string, list, tuple, dictionary), and control structures (loops, conditionals), Basic input/output operations and functions in Python.

NumPy and Pandas for Data Manipulation: Introduction to NumPy: arrays, array operations, and mathematical functions, Data manipulation and analysis with Pandas: Series, DataFrames, indexing, and basic data operations.

UNIT II

Supervised Learning Algorithms: Linear Regression: Understanding the linear regression model and its applications, Implementing linear regression using scikit-learn in Python, model evaluation, and interpretation of results.

Classification Algorithms: Introduction to classification: logistic regression, k-nearest neighbors (KNN), decision trees, and ensemble methods (random forests), Implementing classification algorithms using scikit-learn, evaluating classification models, and handling performance metrics.

UNIT III

Unsupervised Learning Algorithms: Clustering Algorithms: Introduction to clustering: k-means clustering, hierarchical clustering, and density-based clustering (DBSCAN), Implementing clustering algorithms using scikit-learn, evaluating clustering results, and applications in data segmentation.

Dimensionality Reduction: Techniques for dimensionality reduction: principal component analysis (PCA) and t-distributed stochastic neighbor embedding (t-SNE), Implementing dimensionality reduction techniques in Python and visualizing high-dimensional data.

UNIT IV

Advanced Topics in Machine Learning: Support Vector Machines (SVM), Understanding the SVM algorithm for both classification and regression tasks, Implementing SVM using scikit-learn, tuning hyperparameters, and handling non-linear data.

Neural Networks and Deep Learning Basics: Introduction to artificial neural networks (ANNs), deep learning, and deep neural networks (DNNs). Building and training simple neural networks using TensorFlow/Keras in Python for classification and regression tasks.

BOOKS:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien

Géron

2. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili

3. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller and Sarah Guido

MACHINE LEARNING USING PYTHON LAB

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments

1. Perform data preprocessing tasks such as handling missing values, encoding categorical variables, and scaling numerical features. Visualize data distributions, correlations, and relationships using Pandas and Matplotlib libraries.
2. Implement a simple linear regression model using scikit-learn to predict a continuous target variable. Visualize the regression line and residuals to assess model performance.
3. Implement and compare different classification algorithms (e.g., logistic regression, KNN, decision trees) using scikit-learn.
4. Apply the K-Means clustering algorithm to group data points into clusters based on similarity. Visualize clusters and centroids to interpret clustering results.
5. Perform dimensionality reduction using Principal Component Analysis (PCA) to reduce the number of features in a dataset.
6. Implement a Support Vector Machine (SVM) classifier for both linear and non-linear datasets.
7. Build and train a simple artificial neural network (ANN) using Keras and TensorFlow backend.
8. Implement a Convolutional Neural Network (CNN) architecture using Keras for image classification tasks (e.g., MNIST, CIFAR-10).
9. Evaluate CNN performance on test data and visualize feature maps and filters.

BIG DATA ANALYTICS

Semester	4			
Course code	CC-A11			
Category	Core Course(s)			
Course title	Big Data Analytics			
Course ID	241/CS/CC402			
Scheme and Credits	L	T	P	Credits
	3	0	1	4
Theory Internal	25 marks			
Theory External	50 marks			
Practical Internal	5 marks			
Practical External	20 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Identify the characteristics and challenges of big data analytics.

CO2: Implement the Hadoop and MapReduce framework for processing massive volume of data.

CO3: Analyze data by utilizing various statistical and data mining approaches.

CO4: Implement CRUD operations effectively using MongoDB and Report generation using Jaspersoft studio.

CO5: Explore the usage of Hadoop and its integration tools to manage Big Data and use Visualization Techniques.

CO6: Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

UNIT-I

Introduction to Big Data: Types of Digital Data-Characteristics of Data, Evolution of Big Data, Definition of Big Data, Characteristics, Applications & Challenges with Big Data, 3Vs of Big Data, Non-Definitional traits of Big Data, Big Data workflow Management, Business Intelligence vs. Big Data, Distributed file systems.

UNIT-II

Big Data Analytics: Classification of analytics, Data Science, Terminologies in Big Data, CAP Theorem.

Introduction to Hadoop: Features, Advantages, Overview of Hadoop Eco systems, Hadoop distributions, SQL vs. Hadoop, Hadoop Components, Architecture, HDFS.

UNIT-III

Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

NoSQL: Types of Databases, Advantages, SQL vs. NoSQL, NewSQL

Mongo DB: Introduction, Features, Data types, Mongo DB Query language, CRUD operations. Arrays. Functions: Count, Sort, t – Limit, Skip, Aggregate, Map Reduce. Cursors: Indexes, Mongo Import, Mongo Export.

UNIT-IV

Cassandra: Introduction, Features, CQLData types, CQLSH, Key spaces, CRUD operations, Collections, Counter, TTL, alter commands, Import and Export, Querying System tables.

BOOKS:

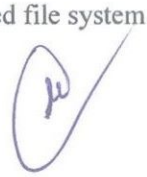
1. T. Erl , W.Khattak and P. Buhler., *Big Data Fundamentals, Concepts, Drivers & Techniques* (1e), The Prentice Hall Service Technology Series, 2016.
2. S. Acharya, *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
3. V. Prajapati, *Big Data Analytics with R and Hadoop*, Packt Publishing Ltd., 2013.
4. A. Holmes, *Hadoop in Practice*, (2e), Manning Publications, 2015
5. S. Ryza, *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017.

BIG DATA ANALYTICS LAB

Note: At least 8 experiments are to be performed by the students.

List of Subject related Experiments:

1. Identify and classify various types of digital data (structured, semi-structured, unstructured). Compare traditional data management approaches with big data management challenges.
2. Install and set up a Hadoop distribution (e.g., Apache Hadoop, Cloudera, Hortonworks). Explore Hadoop components: HDFS (Hadoop Distributed File System), YARN (Yet Another Resource Negotiator), MapReduce.
3. Develop and execute a MapReduce program using Hadoop framework.
4. Implement basic MapReduce tasks such as word count, searching, sorting, and data aggregation.
5. Install and configure MongoDB database management system
6. Implement MongoDB functions: count, sort, limit, skip, aggregate, and map-reduce operations.
7. Setup and configure Apache Cassandra database. Create keyspaces and tables using Cassandra Query Language (CQL).
8. Apply Hadoop and MapReduce for analyzing large datasets. Perform analytics tasks such as data aggregation, statistical analysis, and trend identification.
9. Design and implement a distributed file system using Hadoop HDFS or similar technologies.



Discipline Specific Course from the department for pool of the Courses in the University
(These courses are to be offered to students of different discipline/Subject)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
DSC-1	Data Communication and Computer Networks Or Theory of Computation	241/CS/DS101 241/CS/DS102	2	1	0	2	1	0	3	25	50	-	-	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
DSC-2	Discrete mathematics and statistics Or Mobile Computing	241/CS/DS201 241/CS/DS202	2	1	0	2	1	0	3	25	50	-	-	75

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
DSC-3	Block Chain Technology Or Soft Computing Techniques using Neural Networks	241/CS/DS301 241/CS/DS302	2	1	0	2	1	0	3	25	50	-	-	75

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
DSC-4	Optimization Techniques Or Cloud Computing and IoT	241/CS/DS401 241/CS/DS402	2	1	0	2	1	0	3	25	50	-	-	75

PROGRAMMING WITH C

Semester	3			
Course code	MDC-03			
Category	Multidisciplinary Course(s)			
Course title	Programming with C			
Course ID	241/CS/MD301			
Scheme and Credits	L	T	P	Credits
	2	1	0	3
Theory Internal	25 marks			
Theory External	50 marks			
Total	100 marks			
Duration of Exam	3 hrs			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: understanding algorithms and translating them into structured flowcharts and pseudocode.

CO2: proficiency in writing and debugging C programs, understanding compilation processes, and identifying syntax and logical errors

CO3: understanding of dynamic memory allocation techniques, such as malloc, calloc, and realloc, and apply them in array and structure contexts.

CO4: demonstrate proficiency in passing arrays to functions, using recursion for solving problems (e.g., factorial, Fibonacci series), and handling character arrays.

CO5: understand the basics of file handling in C, including opening, reading, writing, and closing files, and manipulate data using file operations

UNIT-I

Introduction to Programming: Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. C

Programming: Keywords, Variables and Data Types: basic, derived and user defined, Type Conversions, Header Files, Basic Input and Output Functions and Statements, Compilation, Syntax and Logical Errors in compilation, Object and Executable Code, Storage Classes, Arithmetic Expressions and Precedence.

UNIT-II

Preprocessors, Conditional and Branching Statements, Loops/ Iterative Statements, Writing and evaluation of conditionals and consequent branching.

UNIT-III

Arrays (1-D, 2-D), Character Arrays and Strings, Arrays with Pointers, Functions (including using built in libraries), Parameter passing in functions, Call by Value, Call by Reference, Passing arrays to functions, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.

UNIT-IV

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, Introduction to Dynamic Memory Allocation and its Methods, Structures, Union, Defining Structures and Array of Structures, File Handling.

BOOKS:

1. Ajay Mittal, Programming in C, 'A Practical Approach', Pearson Education.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. Yashavant Kanetkar, Let Us C, BPB Publication.
5. Gill, Nasib Singh: Computing Fundamentals and Programming in C, Khanna Book Publishing Company (Private) Limited, New Delhi

CLOUD COMPUTING

Semester	4			
Course code	MDC-04			
Category	Multidisciplinary Course(s)			
Course title	Cloud computing			
Course ID	241/CS/MD401			
Scheme and Credits	L	T	P	Credits
	2	1	0	3
Theory Internal	25 Marks			
Theory External	50 Marks			
Total	75 Marks			
Duration of Exam	3 hours			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Recall and summarize the basic concepts of cloud computing

CO2: Discuss the architectural design of cloud and illustrate various programming models.

CO3: Outline the virtualization technology and determine their uses.

CO4: Explain the basic threats and security mechanism in cloud

CO5: Summarize the cloud available platforms for business and industry perspective

UNIT - I

INTRODUCTION TO CLOUD COMPUTING: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing.

UNIT - II

CLOUD COMPUTING ARCHITECTURE: Requirements, Introduction Cloud ccmputing

architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise .

UNIT - III

SECURITY ISSUES IN CLOUD COMPUTING: Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

SECURITY MANAGEMENT IN THE CLOUD: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

UNIT – IV

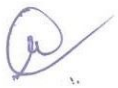
AUDIT AND COMPLIANCE: Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a Cloud.

DATA INTENSIVE COMPUTING: Map-Reduce Programming Characterizing Data-Intensive Computations, Technologies for Data- Intensive Computing, Storage Systems, Programming Platforms, MapReduce Programming, MapReduce Programming Model, Example Application

BOOKS:

1. "Cloud Computing Explained: Implementation Handbook for Enterprises", John Rhoton, Publication Date: November 2, 2009

2. "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009



Skill Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both thecry and lab/hands-on/training/field work.)

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-1	Programming in Python	241/CS/SE201	2	-	-	2	-	-	2	15	35	-	-	50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-2	Numerical Ability & Enhancement Skills	241/CS/SE301	2	-	-	2	-	-	2	15	35	-	-	50

NUMERICAL ABILITY AND ENHANCEMENT SKILLS

Semester	3			
Course code	SEC-02			
Category	Skill Enhancement Course			
Course title	Numerical Ability & Enhancement Skills			
Course ID	241/CS/SE301			
Scheme and Credits	L	T	P	Credits
	2	0	0	2
Theory Internal	15 marks			
Theory External	35 marks			
Total	50 Marks			
Duration of Exam	3 hours			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Understand real number system, fundamental arithmetical operations, use of BODMAS rule and solve typical expressions accurately and fast

CO2: Acquire skill to identify types of given sequences/series and apply suitable method to find a particular term, sum of specific number of terms and practice this learning in real life mathematical problems.

CO3: To formulate equations for specific mathematical problem and making use of mathematical skills to solve that.

CO4: Have a deeper and comprehensive understanding of the basic concepts of Percentage, Profit & Loss, Alligation or mixture, Averages and acquire skill to use this knowledge in real life problems.

CO5: Attain cognitive and analytical skills to identify, analyze and generate solutions to realistic problems by exploring procedural knowledge associated with the problems. Have analytical skills to compare and recognize various geometrical figures available in surroundings with mathematical figures and determine areas and volumes of the same.

UNIT - I

Real number system, Operations on numbers, Tests for divisibility of natural numbers, Decimals, Fractions, Square roots, Cube roots, Surds and indices, Use of BODMAS.

UNIT – II

HCF, LCM of integers, Ratio and Proportion, Progressions: Arithmetic Progression, Geometric Progression, Harmonic Progression with their simple and basic practical applications, Number series completion.

UNIT – III

Percentage, Profit & Loss, Alligation or mixture, Average, Average speed problems, Calendar.

UNIT - IV

Logarithms, Area of Quadrilaterals (Parallelogram, Square, Rectangle, Rhombus, Trapezium), Volume and surface area of Cube, Cuboid, Cylinder, Cone, Sphere and Hemisphere.

BOOKS:

1. R. S. Aggarwal (2022). Quantitative Aptitude. S Chand & Company Limited, New Delhi.
2. A. Guha (2020). Quantitative Aptitude (7 th Edition). Mc Graw Hill Publications.
3. V. Dyke, J. Rogers and H. Adams (2011). Fundamentals of Mathematics, Cengage Learning.
4. A.S. Tussy, R. D. Gustafson and D. Koenig (2010). Basic Mathematics for College Students. Brooks Cole.
5. C. C. Pinter (2014). A Book of Set Theory. Dover Publications.
6. G. Klambauer (1986). Aspects of calculus. Springer-Verlag.

Value Added Course from the department for pool of the Courses in the University

(All the departments will offer value added course for the students of same or different department.)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VAC-1	Blockchain Technology	241/CS/VA101	2	-	-	2	-	-	2	15	35	-	-	50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VAC-2	Cyber Security	241/CS/VA301	2	-	-	2	-	-	2	15	35	-	-	50

CYBER SECURITY

Semester	3			
Course code	VAC-02			
Category	Value Added Course			
Course title	Cyber Security			
Course ID	241/CS/VA301			
Scheme and Credits	L	T	P	Credits
	2	0	0	2
Theory Internal	15 marks			
Theory External	35 marks			
Total	50 Marks			
Duration of Exam	3 hours			

Note: *The examiner will set nine questions in total. Question one will have seven parts from all units and the marks of first question will be of 20% of total marks of Question Paper and the remaining eight questions to be set by taking two questions from each unit and the marks of each question from Question no.2 to 9 will be of 20% of total marks of Question paper. The students have to attempt five questions in total, the first being compulsory and selecting one from each unit.*

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1: Recognize key terms of cyber domain and identify cyber threats

CO2: Understand cyber law concepts, intellectual property rights and digital rights management.

CO3: Diagnose and examine basic security loopholes, anomalous behaviour in Internet.

CO4: Understand principles of Web Security, secure and protect personal data on the Internet.

CO5: Security issues in Blockchain.

UNIT - I

Overview of Cyber Security: Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker, Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.

UNIT - II

Cybercrimes: Cybercrimes targeting Computer systems and Mobiles- data diddling attacks,

spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Crypto-jacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cybercrime against persons-cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

UNIT - III

Cyber Law: Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to: AI/ML, IoT, Blockchain, Darknet and Social media

Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations (GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA), Social media- data privacy and security issues.

UNIT - IV

Cyber security Management, Compliance and Governance: Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National
cyber security policy and strategy.

BOOKS:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.

2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.

4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.

5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.