Appendix- A

SAMBALPUR UNIVERSITY

JYOTI VIHAR, BURLA-768019

Two Year M.Sc. Degree Course in

Computer Science

M.Sc. Computer Science

(Effective from Academic year 2023-2025)

Semester Structure

First Semester - August to December.

Second Semester - January to June.

Third Semester - July to December.

Fourth Semester - January to June.

Course Structure of M.Sc. Computer Science Programme

Semester - I	Semester - II	Semester - III	Semester - IV
Data Structure Using C	Web Technology	Python Programming	Software Engineering
Object Oriented Programming using C++	Database Management System	Design & Analysis of Algorithm	Computer Graphics
Operating System	Data Communication & Computer Networking	Elective – I	Elective – III
Computer Organization and Architecture	Discrete Mathematics	Elective – II	Lab on Computer Graphics
Lab on C++	Lab on Web Technology	Lab on Python Programming	Seminar
Lab on Data Structure	Lab on DBMS	Lab on Design & Analysis of Algorithm	Dissertation/Project
Env. Studies & Disaster Management	Inter Dept. Course (IDC) or Open Elective	MOOCs one paper	
Yuva Sanskar	NCC/NSS/Sports/Performing Arts/Yoga (of which one has to be opted)	Entrepreneurship Development	

Semester - I

Course Code	Course Title	No. of Credits	Hours/Week
CS-C-411	Data Structure Using C	4	4
CS-C-412	Object Oriented Programming using C++	4	4
CS-C-413	Operating System	4	4
CS-C-414	Computer Organization and Architecture	4	4
CS-C-415	Lab on C++	2	2
CS-C-416	Lab on Data Structure	2	2
ESDMS -419	Env. Studies & Disaster Management	2	2
	Yuva Sanskar	0	
Total Credits	**22**	-	

Semester – II

Course Code	Course Title	No. of Credits	Hours/Week
CS-C-421	Web Technology	4	4
CS-C-422	Database Management System	4	4
CS-C-423	Data Communication & Computer Networking	4	4
CS-C-424	Discrete Mathematics	4	4
CS-C-425	Lab on Web Technology	2	2
CS-C-426	Lab on DBMS	2	2
IDC(Dept. Code)-429	Inter Dept. Course (IDC) or Open Elective	3	3
	NCC/NSS/Sports/Performing Arts/Yoga (of which one has to be opted)	0	
Total Credits	**23**	-	

Semester – III

Course Code	Course Title	No. of Credits	Hours/Week
CS-C-511	Python Programming	4	4
CS-C-512	Design & Analysis of Algorithm	4	4
CS-E-513	Elective – I	4	4
CS-E-514	Elective – II	4	4
CS-C-515	Lab on Python Programming	2	2
CS-C-516	Lab on Design & Analysis of Algorithm	2	2
CS-C-517	MOOCs one paper	3	3
EDPS -439	Entrepreneurship Development	2	2
Total Credits	**25**	-	

Semester – IV

Course Code	Course Title	No. of Credits	Hours/Week
CS-C-521	Software Engineering	4	4
CS-C-522	Computer Graphics	4	4
CS-E-523	Elective – III	4	4
CS-C-524	Lab on Computer Graphics	2	2
CS-C-525	Seminar	2	2
CS-C-526	Dissertation/Project	4	4
Total Credits	**20**	-	

Elective – I

1. Internet of Things
2. Theory of Computation

Elective – II

1. Digital Image Processing
2. Artificial Intelligence

Elective – III

1. Information & Cyber Security
2. Data Science

Total Credits of the Course

Semesters	Sem - I	Sem - II	Sem - III	Sem - IV	TOTAL
Credits	22	23	25	20	**90**

NOTE:

- Furthermore, following non-credit course will be taken by the students
  1. Yuva Sanskar in 1st Semester
  2. NSS/ NCC/ Sports/ Performing Arts/ Yoga (any one) in 2nd Semester.
- Students have to opt for a Inter Department Course (IDC) offered by other departments of the university in 2nd Semester.

- Students will, apply in prescribed form their preference for NCC/NSS/sports/Performing Art/Yoga at the beginning of the session, i.e., in 1st Semester.

- The students will take one MOOCs Course other than the core courses present in the MSc Computer Science syllabus. The student may opt according to his/her preference in consultation with HOD from 1st Semester and submit document in support of undertaking the MOOCs course to the Department. Further, the student has to submit the completion certificate of the opted MOOCs course before the exam form fill up in 4th Semester.

First Semester
Course Title: Data Structure Using C
Course Code: CS-C-411
No. of Credits - 4

Objectives

- To understand basics of Data Structure Using C
- To understand data structures like stack, queue, graph
- To understand the applications of Data Structure Using C

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Data Structure Using C, relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of Data Structure Using C
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained

Unit -I
Introduction: Overview of C, Constants, Variable and Data Types, Operators and Expressions: types of operators, associativity, precedence, Decision Making and Control Structure: if, if..else, if..else ladder, switch statement, for loop, while loop, do..while, break, continue.

Unit -II
Arrays: Definition, 1-D, 2-D arrays, initialization and access of elements, strings, function, pointers, Structure,

Unit – III
Introduction to data structures: storage structure for arrays, sparse matrices, Stacks and Queues: representation and application. Linked lists: Single linked lists, linked list representation of stacks and Queues. Operations on polynomials, Double linked list, circular list.

Unit – IV
Infix to Postfix conversion, postfix expression evaluation. Trees: Tree terminology, Binary tree, Binary search tree, General tree, Complete Binary Tree representation, Tree traversals, operation on Binary tree-expression Manipulation. Graphs: Graph terminology, Representation of graphs, path matrix, BFS (breadth first search), DFS (depth first search), topological sorting

Text Books:

1. E. Balaguruswamy, “Programming in ANSI C”, 8th Edition, 2019, McGraw Hill Education
2. Gilberg and Forouzan: “Data Structure- A Pseudo code approach with C” by Thomson publication
3. “Data structure in C” by Tanenbaum, PHI publication / Pearson publication.

Reference Books:

1. B. Kernighan & Dennis Ritchie, “The C Programming Language”
2. “Fundamentals of data structure in C” Horowitz, Sahani & Freed, Computer Science Press.
3. “Fundamental of Data Structure” (Schaums Series) Tata-McGraw-Hill.

FIRST SEMESTER
Course Title: Object Oriented Programming using C++
Course Code: CS-C-412
No. of Credits - 4

Objectives

- To understand basics of OOPS which includes classes, objects etc.
- To understand inheritance, polymorphism concept
- To understand how to use exceptional handling in C++

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Object-Oriented Programming using C++ Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of Object-Oriented Programming using C++
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained

UNIT-I

Object-Oriented programming paradigm, Basic data types, Tokens, Keywords, Identifiers, Variables, Operators: Arithmetic, Relational, Logical, Assignment, Ternary, Bitwise, Unary Operators, Expressions and statements, Input and Output in C++, manipulators with parameters, Flow of control - if, if-else, while, do-while, for loop, Switch, break and continue.

UNIT-II

Single and multidimensional arrays. Character array, string variables, reading multiple lines, arrays of strings, specifying the structure, accessing structure members, array of structures. Classes and objects, Class declaration, Data member and Member functions, private and public members, scope resolution operator

UNIT-III

Inline Functions, passing objects as arguments, returning objects, Function overloading, Friend function, constructors, destructors, overloaded constructors, Types of Constructors, operator overloading: Unary Operator, Binary Operator

UNIT-IV

Inheritance: Derived Class and Base Class, accessing base class members, the protected access specifier, abstract base class, single, multilevel, multiple inheritance, ambiguity in multiple inheritance. Polymorphism, pointers, Virtual base class, Virtual functions & dynamic binding, Exception handling.

Books Recommended:

1. E. Balguruswamy,"Object-Oriented programming with C++",TMH, 5th Edition, 2011
2. R.Lafore,"Object-oriented programming in TURBOC++", Galgotia, 1st Edition, 1997
3. Y.P.Kanetkar,"Let us C++", BPB publication , 2nd Edition, 2015
4. Stanley B. Lippman, Josée Lajoie, "C++ Primer", Pearson Education, 4th Edition

FIRST SEMESTER
Course Title: OPERATING SYSTEM
Course Code: CS-C-413
No. of Credits - 4

Objectives

- To know the basics such as process and CPU scheduling algorithms
- To understand the critical regions and dead lock problem
- To understand virtual memory concept, thrashing problem and page replacement algorithms
- To understand the file tables, access algorithms, and spoofing

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Operating System Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Operating System
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I

Evolution of Operating Systems: Types of operating systems, Operating system services. The process management: Process concept, Process Control Block, Short term, medium term, and long-term Schedulers, Context Switch, Operation on Processes.

UNIT-II

CPU Scheduling: CPU Scheduler, preemptive Scheduling, Scheduling criteria, Scheduling Algorithms-FCFS, SJF, Priority and round robin scheduling. Deadlocks: Necessary conditions for deadlock, Resource Allocation graph, Methods of handling Deadlocks, Deadlock prevention & avoidance, Deadlock Detection and deadlock Recovery

UNIT-III

Memory Management: Logical versus physical Address, Swapping, Single partition allocation, multiple partition allocation, paging, segmentation. Demand paging, Virtual memory, page fault, Page replacement algorithms-FIFO, Optimal, LRU.

UNIT-IV

File Systems: general model of a file system, Disk structure, disk scheduling: FCFS scheduling, SSTF scheduling, SCAN scheduling, C-SCAN scheduling, LOOK scheduling.

Books Recommended:

1. Silberschatz& P.B. Galvin, "Operating Systems Concepts", Addison - Wesley, 9th Edition, 2012
2. Tanenbaum," Modern Operating System", Pearson Education, 3rd Edition, 2015
3. William Stallings ,"Operating Systems: Internals and Design Principles", 6th Edition
4. Dhananjay Dhamdhere, "Operating System a Concept Based Approach", 3rd Edition, 2017

FIRST SEMESTER
Course Title: COMPUTER ORGANIZATION AND ARCHITECTURE
Course Code: CS-C-414
No. of Credits - 4

Objectives

- To impart the essential knowledge on the fundamentals and applications of digital circuits and digital computing principles
- To provide an overview on the design principles of digital computing systems
- To provide technical knowledge about various digital hardware components

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Computer Organization and Architecture Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Computer Organization and Architecture
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I:

Basic organization of the computer and block level description of the functional units as related to the execution of a program. Digital logic gates, Boolean algebra, Boolean Function and simplification, Simplification of Boolean function using K-Map. Canonical form of Boolean functions-SOP and POS.

UNIT-II:

Combinational and Sequential Circuits- Adders, Subtractors, Carry-Look-Ahead (CLA) adder, encoder and decoders, multiplexer and demultiplexer. Flip Flops- RS, JK, D, T and Master Slave Flip Flops. Registers and counters.

UNIT-III:

CPU Organization: Instruction codes, Computer Instructions, Instruction Cycles, Execution of Instructions, Instruction Formats (Zero, One and Two address instruction), Addressing Modes, Discussions about RISC versus CISC architectures.

UNIT-IV:

Memory and IO access: Memory maps, Read Write operation, Programmed IO and interrupt driven IO, DMA controller and data transfer. Memory organization: static and dynamic memory, Memory Hierarchy, cache memory and its access techniques; Virtual memory.

Books Recommended:

1. M. Morris Mano, "Computer System Architecture", PHI, 3rd Edition
2. William Stallings , "Computer Organization and Architecture", Pearson / PHI, 9th Edition, 2013
3. B.RAM , "Fundamentals of Microprocessor and Microcontrollers", Dhanpat Rai Publication, 2010 Edition

FIRST SEMESTER
Course Title: LAB ON C++ PROGRAMMING
Course Code: CS-C-415
(Based on Paper-MSC 412: Object Oriented Programming using C++
No. of Credits - 2

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Lab on C++ Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of Lab on C++
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

FIRST SEMESTER
Course Title: LAB ON DATA STRUCTURE
Course Code: CS-C-416
(Based on Paper-MSC 411: Data Structure Using C)
No. of Credits - 2

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Lab on Data Structure Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Lab on Data Structure
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

FIRST SEMESTER
Course Title: ENV. STUDIES & DISASTER MANAGEMENT
Course Code: ESDMS -419
No. of Credits - 2

SECOND SEMESTER

Course Title: Web Technology
Course Code: CS-C-421

Objectives

- To understand basic concept of java, internet and web browsing
- Learn to create web page using HTML
- Learn to format the web page
- Learn to host own website on internet
- To understand the basics of PHP and MYSQL

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Web Technology Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Web Technology
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit I

Java Keywords, Identifiers, Data types, Variables, Operators: Arithmetic, Relational, Logical, Assignment, Bitwise, Conditional Operators, Special Operators, Expressions and statements, Flow of control - if, if-else, while, do-while, for loop, switch statement, label, break and continue.

Unit-II

Array in Java, classes and Objects in Java, Inheritance: Derived Class and Base Class, specifying the derived class, accessing base class members, Single Level, super, this, Multilevel, Hierarchical, Multiple Inheritance through Interface. Java Threads.

Unit- III

Basics of HTML, JavaScript: Client-side scripting, what is Java script, how to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

Ajax: Introduction, advantages & disadvantages, Purpose of it, ajax based web application, alternatives of ajax

Unit-IV

Basics of CSS, PHP: Starting to script on server side, Arrays, function and forms, advance PHP, cookies, sessions Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

Books Recommended:

1. Steven Holzner," HTML Black Book " , Dreamtech press.
2. Web Technologies, Black Book , Dreamtech press.
3. Web Applications : Concepts and Real World Design, Knuckles, Wiley
4. Herbert Schildt, "JAVA- The Complete Reference", Mcgraw Higher Ed, 7th Edition, 2007
5. David Flanagan**,** "Java in Nutshell", O'Reilly, 6th Edition, 2015
6. E. Balaguruswami,"Programming with JAVA 5th Edition", Mcgraw Higher Ed, 5th Edition, 2014

No. of Credits - 4

SECOND SEMESTER

Course Title: DATABASE MANAGEMENT SYSTEM

Course Code: CS-C-422

No. of Credits - 4

Objectives

- To understand the different database models and language queries to access databases
- To understand the normalization forms in building an effective database table
- To protect the data and the database from unauthorized access and manipulation
- To get basic idea about transaction and concurrency control system
- To get basics of distributed databases

Programme Education Objectives

PEO1	Understand the nature and basic concepts of DBMS
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of DBMS
CO2	Analyse the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I

Database: Definition, Database Management, Structure, Limitations of traditional file processing systems, Advantages and disadvantages of DBMS, Users of DBMS. Components of DBMS, Data Independence and 3-tier architecture and View of Data. Data Model: Hierarchical, Network, Relational, Entity Relationship model: Concepts of entity, entity set, attributes, E-R diagram.

UNIT-II

Relational Query Languages, Relational Algebra and operations, Tuple and Domain Relational Calculus, Functional Dependency, Super key, Candidate Key, Primary Key, Alternate and foreign keys. Strong and weak entities. Integrity constraints. SQL- Languages: DDL, DML and DCL.

UNIT-III

Relational Database Design: Normal Forms (1NF, 2NF, 3NF, BCNF), Decomposition, Dependency Preservation and Lossless Join. Codd's rules. Object Oriented Databases Need for OODBMS, Object structure: Class, polymorphism, encapsulation, inheritance.

UNIT-IV

The distributed databases -Motivation for Distributed Database, Distributed Database concepts. Transaction Management: Transaction Management and Concurrency Control Transaction: Properties (ACID), states, Commit, Rollback Concurrency: Control, Lost update problems, Locks, two phase locking, serialization.

Books Recommended:

1. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw Hill, 4th Edition 2002
2. Elmasari, Navathe," Fundamentals of Database Systems", Pearson, 7th Edition, 2016

3. Ramakrishnan, "Database Management Systems", Mcgraw Higher Ed, 3rd Edition, 2014
4. Atul Kahate,"Introduction to Database Management Systems", Pearson Education, 1st Edition,2004

SECOND SEMESTER
Course Title: DATA COMMUNICATION & NETWORKING
Course Code: CS-C-423
No. of Credits - 4

Objectives

- To provide insight about networks, topologies, and the key concepts
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities
- To understand the principles, key protocols, and significance of each layer in ISO and TCP/IP

Programme Education Objectives

PEO1	Understand the nature and basic concepts of DATA COMMUNICATION & NETWORKING Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of DATA COMMUNICATION & NETWORKING
CO2	Analyse the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I:

Overview of Data Communications and Networking. Networking - Needs and Advantages, Network Types- Client, Server and Peers. Network Topology-Bus, Ring, Star and Mesh Topologies. Mode of data communication. Physical Layer: Analog and Digital, data and signals, Signal properties, Data Rate Limits, Transmission Impairment.

UNIT-II

Digital Transmission: Line coding, Pulse Code Modulation(PCM), Transmission mode. Analog Transmission: Modulation of Digital Data (ASK, FSK, PSK, QAM), Modulation of Analog signals (AM, FM, PM). Multiplexing: FDM, WDM and TDM, Transmission Media: Guided Media, Unguided media (wireless)

UNIT-III

Data Link Layer: Flow and error Control, Stop-and-wait ARQ. Go-Back-N -ARQ, Selective Repeat ARQ, Point-to-Point Access: Point-to Point Protocol, Multiple-Access: Random Access, Controlled Access, Channelization. Local Area Network: Ethernet, Token bus (IEEE- 802.4), Token ring (IEEE-802.5).

UNIT-IV

Network Layer: Internetworking, IPv4 addressing and Subnetting, IPv6 Address, Internet Protocol (IP), Transport Layer: Process to process Delivery, Client Server Paradigm, Port Number, UDP, TCP congestion control. Application Layer: Domain Name System (DNS), Electronic Mail, and File transfer (FTP), Telnet, HTTP and WWW,

Books Recommended:

1. B.A. Forouzan,"Data Communication and Networking", TMH, 4th Edition, 2006
2. A.S. Tannenbaum, "Computer Networks", Pearson, 5th Edition, 2012

3. William Stallings , "Data and Computer Communications", Pearson, 8th Edition, 2009

SECOND SEMESTER
Course Title: DISCRETE MATHEMATICS
Course Code: CS-C-424
No. of Credits - 4

Objectives

- To get familiar and understand the fundamental notions in discrete mathematics
- To understand and demonstrate the basic concept of an algorithm and its application in combinatorial mathematics
- To identify the basic properties of graphs and trees and model simple applications
- To understand the basic concept of group theory and its application
- To get familiar with some statistical measures

Programme Education Objectives

PEO1	Understand the nature and basic concepts of DISCRETE MATHEMATICS Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of DISCRETE MATHEMATICS
CO2	Analyse the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT - I

Fundamentals of logic, Prepositional equivalences, Predicates and Quantifiers, Mathematical Induction. Sets, Set operations, Properties of binary relations, Equivalence relations and partitions, Partial ordering relations and lattices, Properties of lattices, Distributive and Complemented lattices, Boolean algebra,

UNIT - II

The basics of counting, Permutations and Combinations, Recurrence relations, Solving Recurrence relations, Generating functions

UNIT - III

Groups, Subgroups, Cosets and Lagrange's Theorem, Codes and Group codes, Homomorphism and Normal subgroups, Isomorphism, Ring, Integral Domains and Fields.

UNIT-IV

Introduction to graphs, Graph terminology, Representing graphs and Graph isomorphism, Euler and Hamilton paths, Introduction to trees, Applications of trees.

Frequency Distribution, Measures of Central Tendencies, Dispersion, Skewness, Kurtosis, Mathematical Expectation.

Books Recommended:

1. Kenneth H. Rosen, "Discrete Mathematics & Its Application", TMH, 7th Edition, 2011
2. C. L. Liu, "Elements of Discrete Mathematics", TMH, 2nd Edition, 2000
3. BernardiKolman, Robert C. Busby, Sharon Ross, "Discrete Mathematical Structure", PHI, 6th Edition, 2008
4. S.P.Gupta,"Statistical Methods", S.Chand& Sons, 2011 Edition

SECOND SEMESTER
Course Title: LAB ON WEB TECHNOLOGY
Course Code: CS-C-425
(Based on Paper- CS-C-421: WEB TECHNOLOGY)
No. of Credits - 2 F.M. -100

Programme Education Objectives

PEO1	Understand the nature and basic concepts of LAB ON WEB TECHNOLOGY Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of LAB ON WEB TECHNOLOGY
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

SECOND SEMESTER
Course Title: LAB ON DBMS
Course Code: CS-C-426
(Based on Paper- CS-S-422: DATABASE MANAGEMENT SYSTEM)
No. of Credits - 2 F.M. -100

Programme Education Objectives

PEO1	Understand the nature and basic concepts of LAB ON DBMS Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of LAB ON DBMS
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

SECOND SEMESTER
Course Title: Inter Department Course (IDC)
Course Code: IDCCSA-429
No. of Credits - 3

Students have to opt for a Inter Department Course (IDC) offered by other departments of the university.

THIRD SEMESTER
Course Title: Python Programming
Course Code: CS-C-511
No. of Credits - 4

Objectives

- To enable the students to understand the basic principles of the Python Language.
- To use the tools to do simple programs in python.

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Python Programming Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of Python Programming
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Introduction: Installation, First Python Program: Interactive Mode Programming, Script Mode Programming; Identifiers, Reserved Words, Lines and Indentation, Multi-Line Statements, Quotation & Comments; Assigning Values to Variables, Multiple Assignment.

Unit-II

Standard Data Types: Numbers, Strings, Lists, Tuples, Dictionary, Set; Basic Operators: Arithmetic, Comparison, Assignment, Bitwise; Python Numbers & Mathematical functions.

Unit-III

Python statements and Loops: if, if-else, While, for loops, break, continue, pass; Functions: Definition, call, positional and keyword parameter. Default parameters, variable number of arguments, lambda function.

Unit-IV

Object Oriented Programming: classes and objects – Inheritance, Polymorphism; Error handling & Exceptions - try, except and raise, File Processing: reading and writing files.

Books Recommended:

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
2. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012

THIRD SEMESTER
Course Title: DESIGN AND ANALYSIS OF ALGORITHM
Course Code: CS-C-512
No. of Credits - 4

Objectives

- To understand the importance of algorithm and its complexity
- To analyse the complexity of an algorithm in terms of time and space complexities
- To design and implement various programming paradigms and its complexity

Programme Education Objectives

PEO1	Understand the nature and basic concepts of the subject
PEO2	To understand the importance of algorithm and its complexity
PEO3	To design and implement various algorithm design paradigms
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of DESIGN AND ANALYSIS OF ALGORITHM
CO2	Analyse the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I

Algorithms and Complexity: Introduction to Algorithm, Asymptotic Notations and Basic Efficiency Classes (Big O, θ, Ω, ω, little o) in analysis of algorithms. Growth of functions, Recurrences: Recursive algorithms, Substitution method, Recurrence Tree method, Master method.

UNIT-II

Sorting and Searching Techniques: Bubble Sort, Insertion Sort, Sequential Search, Binary Search, Depth First Search and Breadth First Search, Divide and Conquer Paradigm: problem solving, Algorithm design and Complexity of Merge Sort, Quick Sort. Heap Sort: Heaps, Maintaining Heap property, Building a heap, Heap Sort algorithm, Priority Queues.

UNIT-III

Greedy Techniques: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's and Bellman Ford Algorithm, Huffman Trees, Fractional Knapsack problem. Dynamic Programming Paradigm : Floyd-Warshall Algorithm, Matrix Chain Multiplication Problem, Longest Common Subsequence Problem, 0/1 Knapsack Problem.

UNIT-IV

Travelling Salesman Problem and its State Space Search Tree. Introduction to Computability: Complexity Classes, P, NP, NP-Hard, NP-Completeness and Reducibility, Approximation Algorithms: Vertex Cover Problem.

Books Recommended

1. Horowitz E. &Sahni S and S.Rajasekaran,"Fundamentals of Computer Algorithms", Universities Press, 2nd Edition, 2008
2. Aho, Hopcroft & Ullman, "The Design and Analysis of Computer Algorithms", Pearson, 1st Edition, 1974
3. T.H.Coremen, C.E Leiserson, R.L.Rivest and C.Stein," Introduction to Algorithms", PHI, 3rd Edition, 2009.

THIRD SEMESTER
Course Title: ELECTIVE - I
Course Code: CS-C-513
No. of Credits - 4

THIRD SEMESTER
Course Title: ELECTIVE - II
Course Code: CS-C-514
No. of Credits - 4

THIRD SEMESTER
Course Title: LAB ON PYTHON PROGRAMMING
(Based on Paper- CS-C-511: PROGRAMMING WITH PYTHON)
Course Code: CS-C-515
No. of Credits - 2

Programme Education Objectives

PEO1	Understand the nature and basic concepts of LAB ON PYTHON PROGRAMMING Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of LAB ON PYTHON PROGRAMMING
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

THIRD SEMESTER
Course Title: LAB ON DESIGN & ANALYSIS OF ALGORITHM
(Based on Paper- CS-C-512: DESIGN & ANALYSIS OF ALGORITHM)
Course Code: CS-C-516
No. of Credits - 2

Programme Education Objectives

PEO1	Understand the nature and basic concepts of LAB ON DESIGN & ANALYSIS OF ALGORITHM Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of LAB ON DESIGN & ANALYSIS OF ALGORITHM
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

THIRD SEMESTER
Course Title: MOOCs
Course Code: CS-C-517
No. of Credits - 3

Students have to opt for a MOOCs course offered in SWAYAM/ NPTEL platform.

FOURTH SEMESTER
Course Title: Software Engineering
Course Code: CS-C-521
No. of Credits - 4

Objectives

- To understand the importance of software engineering lifecycle models in the development of software
- To understand the various design principles in modelling a software
- To develop a software which adheres to the standard benchmarks
- To undergo the technical knowledge in the process of software testing outcomes

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Software Engineering &OOAD Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Software Engineering &OOAD
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I

Introduction: Software Life cycle Models, project planning, metrics (LOC, Functional Point), estimation techniques: empirical and heuristic (COCOMO), Scheduling: Work Breakdown Structure, Critical Path Method, PERT chart, Risk management, Requirements analysis and specification: Requirement gathering and analysis, Software Requirement Specification.

UNIT-III

Software Design: Overview of Design, Cohesion and coupling, Function oriented software design: Data Flow Diagrams, Object-oriented Design: Object modeling using UML, use case diagram, class diagram, Interaction diagrams: activity diagram, Package, Component and Deployment diagram, State chart Diagram.

UNIT-IV

Coding and Testing: Coding, Code review, software documentation, testing, unit testing, black box and white box testing, integration and system testing. Maintenance: Characteristics, maintenance tasks, types of maintenance, software maintenance process models, Estimation of maintenance cost.

UNIT-IV

Software quality: SEI CMM and ISO-9000. Software reliability and fault-tolerance. Computer-aided software engineering (CASE): Characteristics of CASE Tools, Architecture of CASE environment, Software reuse.

Books Recommended:

1. Rajib Mall," Fundamentals of Software Engineering", PHI, 4th edition.
2. R.S. Pressman, "Software Engineering Practitioner's Approach", TMH, 7th Edition, 2010
3. Pankaj Jalote, "A Concise Introduction to Software Engineering", Springer

FOURTH SEMESTER
Course Title: Computer Graphics
Course Code: CS-C-522
No. of Credits - 4

Objectives

• To be able to learn the core concepts of Computer Graphics.
• To be able to create effective programs for solving graphics problems.

Programme Education Objectives

PEO1	Understand the nature and basic concepts of Computer Graphics Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO-1	Remember and understand the basic concepts/Principles of Computer Graphics
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit I

Computer Graphics: A Survey of Computer graphics, Overview of Graphics System: Video Display Devices, Raster-Scan Systems, Input Devices, Hard-Copy Devices, Graphics Software.

Unit-II

Graphics Output Primitives: Point and Lines, Algorithms for line, circle & ellipse generation, Filled-Area Primitives. Attributes of Graphics Primitives: Point, line, curve attributes, fill area attributes, Fill methods for areas with irregular boundaries.

Unit- III

Geometric Transformations (both 2-D & 3-D): Basic Geometric Transformations, Transformation Matrix, Types of transformation in 2-D and 3-D Graphics: Scaling, Reflection, shear transformation, rotation, translation. 2-D,3-D transformation using homogeneous coordinates.

Unit-IV

Two-Dimensional Viewing: Introduction to viewing and clipping, viewing transformation in 2-D, Viewing pipeline, Clipping Window, Clipping Algorithms: Point clipping, Line clipping and Polygon clipping.

Books Recommended:

1. Mathematical Elements for Computer Graphics,D.F.Rogers&J.A.Adams, MGH, 2/ed.
2. Donald Hearn & M. Pauline Baker, “Computer Graphics with OpenGL”, Pearson Education.
3. D. F. Rogers, “Procedural Elements for Computer Graphics”, MGH

FOURTH SEMESTER
Course Title: ELECTIVE - III
Course Code: CS-C-523
No. of Credits - 4

FOURTH SEMESTER
Course Title: Lab on Computer Graphics
Course Code: CS-C-524
No. of Credits - 2

Programme Education Objectives

PEO1	Understand the nature and basic concepts of LAB ON COMPUTER GRAPHICS Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of LAB ON COMPUTER GRAPHICS
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

FOURTH SEMESTER
Course Title: Seminar
Course Code: CS-C-525
No. of Credits - 2

FOURTH SEMESTER
Course Title: Dissertation/ Project
Course Code: CS-C-526
No. of Credits - 4

Project work of 4th Semester will be assigned to the student(jointly or individually) at the beginning of the 3rd semester and will be completed in the 4th semester.

Semester wise work and distribution of marks in % for project			
III Semester (20%) Evaluation of Interim Report of the Project Work			
Background of the Problem (5%)	Review of Literature (5%)	Objectives (5%)	Methodology (5%)
IV Semester (80%) Evaluation of Final Report of the Project Work			
Project work (50%)		Viva (30%)	

SECOND SEMESTER
Course Title: COMPUTER FUNDAMENTAL
Inter Dept. Course (IDC) or Open Elective
Course Code: IDC(CSA)-429
No. of Credits -3

Unit-1
Introduction: Introduction to computer system, uses, types.
Data Representation: Number systems and character representation, binary arithmetic,
Software: Introduction, types of software, fundamentals of Operating system, utility programs

Unit-2
Input and output devices (with connections and practical demo): keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer
Computer Memory: Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks

Unit-3
Computer Organization and Architecture Fundamentals: C.P.U., registers, system bus, main memory unit, cache memory,
Computer Networking Fundamentals: Introduction, Types of Networks, Internet, Email, Client-Server, Web Services.

Recommended Books:

1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007

Elective – I
Course Title: INTERNET OF THINGS
Course Code: CS-E-513

Objectives

- To provide insight about Intent of Things, topologies, and the key concepts
- To gain comprehensive knowledge about the IoT connectivity, Data Protocols, Communication Protocols.
- To understand the principles and process to implement IoT applications.
- To understand the integration of Cloud services with IoT devices to witness real-time IoT communication.

Programme Education Objectives

PEO1	To understand the fundamentals of Internet of Things.
PEO2	To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
PEO3	To apply the concept of Internet of Things in the real-world scenario
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Student should be able to design a portable IoT using Arduino/ equivalent boards and relevant protocols.
CO2	Student should be able to develop web services to access/control IoT devices.
CO3	Student should be able to deploy an IoT application and connect to the cloud.
CO4	Student should be able to analyse applications of IoT in real time scenario

UNIT-I

Introduction to Internet of Things: Sensing, Actuation, Basic components of IoT, Applications, Service Oriented Architecture, Basics of associated technologies with IoT (Cloud Computing, WSN, IoV, M2M, CPS, IoE), Challenges in IoT,

UNIT-II

Connectivity: IPv6, RPL ,
Data Protocol: MQTT, CoAP, AMQP
Communication Protocols: IEEE 802.15.4, ZigBee, 6LowPAN, Bluetooth, NFC, RFID

UNIT-III

Implementation of IoT: Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED and push button, Basic Networking with ESP8266 Wi-Fi module, Various Wi-Fi library, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

UNIT-IV

Cloud Computing: Recent trends in Computing, NIST visual model, Characteristics, components, service model (SaaS, PaaS, IaaS), Public cloud, private cloud and hybrid clouds, Service management and security, Cloud simulators, Open-source clouds, commercial clouds, IOT Cloud platforms, ThingSpeak API, Interfacing ESP8266 with Web services

Books Recommended:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

Elective – I
Course Title: THEORY OF COMPUTATION
Course Code: CS-E-513

Objectives

- To learn the fundamental concepts of THEORY OF COMPUTATION
- To study basics of theory of computation
- To identify different formal language classes and their relationships.
- To expose students to current applications in the field of theory of computation

Programme Education Objectives

PEO1	Understand the nature and basic concepts of THEORY OF COMPUTATION Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Design Finite Automata machines for given problems & analyse a given Finite Automata machine and find out its Language
CO2	Design Pushdown Automata machine for given CF language(s)
CO3	Generate the strings/sentences of a given context-free language using its grammar.
CO4	Design Turing machines for any computational problem.

UNIT – I

Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata.

UNIT – II

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non-Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

UNIT – III

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

UNIT – IV

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

TEXT BOOKS:

(1) John E. Hopcroft, Rajeev Motwani and Jeffery D. Ullman, Automata Theory, Languages, and Computation (3rd. Edition), Pearson Education, 2008.

REFERENCE BOOKS:

(1) H.R.Lewis and C.H.Papadimitriou, Elements of The theory of Computation, Second Edition, Pearson Education/PHI, 2003

(2) Michael Sipser, Introduction to the Theory of Computation, Books/Cole Thomson Learning, 2001.

(3) J.E. Hopcroft and JD Ullman, Introduction to Automata Theory, Languages, and Computation, Addison-Wesley, 1979.Richard F. Gilberg & Behrouz A. Forouzan, Data Structures: A pseudocode approach with C, CENGAGE Learning.

Elective – II
Course Title: DIGITAL IMAGE PROCESSING
Course Code: CS-E-514

Objectives

- To learn the fundamental concepts of Digital Image Processing
- To study basic image processing operations
- To understand digital image processing algorithms
- To expose students to current applications in the field of digital image processing

Programme Education Objectives

PEO1	Understand the nature and basic concepts of DIGITAL IMAGE PROCESSING Relating to the M.Sc. Degree in Computer Sciences

PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of DIGITAL IMAGE PROCESSING
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT-I

What is Digital Image Processing, Fundamental Steps in Digital Image Processing, Elements of Visual Perception, Image Sampling and Quantization, Some basic relationships between Pixels, Image Enhancement: Gray Level Transformation: Image Negatives, Log Transformations, Histogram Processing: Histogram Equalization, Basics of Spatial Filtering

UNIT-II

Image Transforms; Fourier Transform and their properties, Smoothing Frequency-Domain Filtering: Ideal, Butterworth, Gaussian Low pass Filters, Sharpening Frequency Domain Filtering: Ideal, Butterworth, Gaussian High pass Filters.

UNIT-III

Image Restoration: A model of the Image Degradation/Restoration Process, Noise Models. Restoration in the Presence of Noise Only-spatial Filtering. Estimating the Degradation Function. Inverse Filtering. Minimum Mean Square Error (Wiener) Filtering. Morphological Image Processing: Preliminaries. Dilation and Erosion. Opening and Closing, The Hit-or- Miss Transformation.

UNIT-IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression: Variable length coding, LZW coding, Image Segmentation: Detection of Discontinuity, Edge linking and Boundary Detection, Region based Segmentation.

Books Recommended:

1. R.C.Gonzalez&R.E.Wood, "Digital Image Processing", Addison Wesley.
2. B.Channda&D.Dutta,"Digital Image Processing and Analysis", PHI, 2nd Edition, 2011
3. A.K.Jain, "Fundamentals of Digital Image Processing",Pearson Education, 1st Edition, 2015

Elective – II
Course Title: ARTIFICIAL INTELLIGENCE
Course Code: CS-E-514

Objectives

- To learn the fundamental concepts of artificial intelligence
- To study basic concept of artificial intelligence
- To understand artificial intelligence algorithms
- To expose students to current applications in the field of artificial intelligence

Programme Education Objectives

PEO1	Understand the nature and basic concepts of ARTIFICIAL INTELLIGENCE Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of ARTIFICIAL INTELLIGENCE
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT – I

Introduction to Artificial Intelligence: AI Problems, AI Techniques, Problems, Problem Space and Search, Defining the problem as a state space search, Production system, Problem characteristics Heuristic search Technologies: Generate and Test, Hill Climbing, Best First Search, Problem Reduction, means-end-analysis, optimal and A*, AND-OR Graphs, AO* Algorithms.

UNIT – II

Representation Knowledge using Predicate Logic: representing simple facts in logic, Representing Instance and ISA relationships, Computable functions and Predicates, Resolution, Representing Knowledge using Rules, Forward Vs Backward Reasoning, Matching, Control Knowledge, Weak slot and Filter structures, Semantic nets, Frames.

UNIT – III

Strong slot and Filter structures, Conceptual Dependencies, Scripts. Introduction to Non-monotonic reasoning, Logics for Non-monotonic reasoning, Implementation: Depth First Search, Dependency-Directed Back Tracking, Justification based Truth Maintenance Logic based Truth Maintenance systems, Statistical Reasoning, Probability and Bayes Theorem, Certainty factors, Rule based Systems, Bayesian Networks, Dempster-Shaffer Theory.

UNIT – IV

Minmax search, alpha-beta cutoffs, Planning system, Goal stack planning, Hierarchical Planning, Natural Language Processing., Syntactic Analysis, Semantic Analysis, Discuses and Pragmatic Processing. Introduction and Fundamentals of Artificial Neural Networks, Biological Prototype, Artificial Neuron, Single Layer Artificial Neural Networks, Multilayer Artificial Neural Networks, Training of Artificial Neural Networks

TEXT BOOKS:

(1) Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
(2) Neural Computing: Theory and practice- Waserman.

REFERENCE BOOKS:

(1) Artificial Intelligence Structures and Strategies complex problem solving-George F. Lugar Pearson Education
(2) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
(3) Dan W. Patterson, Artificial Intelligence and Expert Systems, PHI.
(4) Neural Networks: A Comprehensive Foundation 2/e- Symen Pearson Education.

Elective – III
Course Title: INFORMATION & CYBER SECURITY
Course Code: CS-E-523

Objectives

- To learn the fundamental concepts of information & cyber security
- To study basic concept of information & cyber security
- To understand information & cyber security algorithms
- To expose students to current applications in the field of information & cyber security

Programme Education Objectives

PEO1	Understand the nature and basic concepts of INFORMATION & CYBER SECURITY Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles of INFORMATION & CYBER SECURITY
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

UNIT – I

Attacks on Computers and Computer Security: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography: Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

UNIT – II

Symmetric key Ciphers: Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Cryptanalysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution Asymmetric key Ciphers: Principles of public key cryptosystems1 Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.

UNIT – III

Message Authentication Algorithms and Hash Functions: Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, Whirlpool, HMAC, CMAC, Digital signatures, knapsack algorithm Authentication Applications: Kerberos, X.509 Authentication Service, Public — Key Infrastructure, Biometric Authentication.

UNIT – IV

E-Mail Security: Pretty Good Privacy, S/MIME

IP Security: lP Security overview, IP Security architecture, Authentication Header, encapsulating security payload, Combining security associations, key management.

Web Security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction.

Intruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls.

TEXT BOOKS:

(1) Cryptography and Network Security: William Stallings, Pearson Education,4t" Edition.

(2) Cryptography and Network Security: Atul Kahate, McGraw Hill, 2nd Edition.

REFERENCE BOOKS:

(1) Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1' Edition.

(2) Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill, 2 Edition.

(3) Information Security, Principles and Practice: Mark Stamp, Wiley India.

(4) Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.

Elective – III
Course Title: DATA SCIENCE
Course Code: CS-E-523

Objectives

- To learn the fundamental concepts of data science
- To study basic concept of data science
- To understand data science implementation
- To expose students to current applications in the field of data science

Programme Education Objectives

PEO1	Understand the nature and basic concepts of DATA SCIENCE Relating to the M.Sc. Degree in Computer Sciences
PEO2	Analyze the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Course Outcomes

CO1	Remember and understand the basic concepts/Principles DATA SCIENCE
CO2	Analyze the Various Concepts to understand them through case studies
CO3	Apply the knowledge in understanding practical problems
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-1

Data Scientist's Tool Box: Turning data into actionable knowledge, introduction to the tools that will be used in building data analysis software: version control, markdown, git, GitHub, R, and RStudio.

Unit-2

R Programming Basics: Overview of R, R data types and objects, reading and writing data, Control structures, functions, scoping rules, dates and times, Loop functions, debugging tools, Simulation, code profiling.

Unit-3

Getting and Cleaning Data: Obtaining data from the web, from APIs, from databases and from colleagues in various formats, basics of data cleaning and making data "tidy".

Unit-4

Exploratory Data Analysis: Essential exploratory techniques for summarizing data, applied before formal modeling commences, eliminating or sharpening potential hypotheses about the world that can be addressed by the data, common multivariate statistical techniques used to visualize high-dimensional data.

Text Books

1. Rachel Schutt, Cathy O'Neil, "Doing Data Science: Straight Talk from the Frontiline" by Schroff/O'Reilly, 2013.

Reference Books

1. Foster Provost, Tom Fawcett, “Data Science for Business” What You Need to Know About Data Mining and Data-Analytic Thinking by O'Reilly, 2013.
2. John W. Foreman, “Data Smart: Using data Science to Transform Information into Insight” by John Wiley & Sons, 2013.
3. Eric Seigel, “Predictive Analytics: The Power to Predict who Will Click, Buy, Lie, or Die", 1st Edition, by Wiley, 2013.