# INT. M.SC. SYLLABUS

## Academic Year 2020-2021


# Department of Computer Science

## School of Mathematics, Statistics and Computational Sciences

# Central University of Rajasthan

NH-8 Jaipur- Ajmer Highway, Bandarsindri
Kishangarh -305817
District-Ajmer, Rajasthan
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## Scheme of Integrated M.Sc. Computer Science

The details of the courses with code, title and the credits assign are as given below.

**Course Category**

CC: Compulsory Course, EC: Elective Course, AECC: Ability Enhancement Compulsory Course

**Course Code:** First 3 Characters (Departmental Code), First digit (Course level), Next 2 digits (Serial of the course).

**Semester – I**

| S. No. | Course Code | Course t Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-101 | Computer Fundamentals & Programming in C | CC | 2 | 1 | 0 | 3 |
| 2 | CSC-102 | C Programming Lab | CC | 0 | 0 | 2 | 1 |

**Semester-II**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-103 | Object Oriented Programming in C++ | CC | 2 | 1 | 0 | 3 |
| 2 | CSC-104 | C++ Programming Lab | CC | 0 | 0 | 2 | 1 |

**Semester – III**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-201 | Data Structures | CC | 2 | 1 | 0 | 3 |
| 2 | CSC-202 | Data Structure Lab | CC | 0 | 0 | 2 | 1 |

**Semester – IV**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-203 | Database Management System | CC | 2 | 1 | 0 | 3 |
| 2 | CSC-204 | Database Management Lab | CC | 0 | 0 | 2 | 1 |

**Semester-V**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-301 | Computer Networks | CC | 3 | 0 | 2 | 4 |
| 2 | CSC-302 | Operating System | CC | 3 | 1 | 0 | 4 |
| 3 | CSC-303 | Software Engineering | CC | 3 | 1 | 0 | 4 |
| 4 | | Elective-I (Science) | EC | 3 | 0 | 0 | 3 |
| 5 | | Elective-II | EC | 3 | 0 | 0 | 3 |
| Total | | | | | | | 18 |

**Semester-VI**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-304 | Design & Analysis of Algorithms | CC | 3 | 0 | 2 | 4 |
| 2 | CSC-305 | Theory of Computation | CC | 3 | 0 | 0 | 3 |
| 3 | CSC-306 | Computer Systems Architecture | CC | 3 | 0 | 0 | 3 |
| 4 | CSC-307 | Project + Seminar | CC | 0 | 0 | 4 | 2 |
| 5 | | Elective III (Science) | EC | 3 | 0 | 0 | 3 |
| 6 | | Elective IV | EC | 3 | 0 | 0 | 3 |
| Total | | | | | | | 18 |

**Semester-VII**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-401 | Introduction to Artificial Intelligence | CC | 3 | 0 | 0 | 3 |
| 2 | CSC-402 | Logic in AI | CC | 4 | 0 | 0 | 4 |
| 3 | CSC-403 | Probability & Statistics | CC | 4 | 0 | 0 | 4 |
| 4 | CSC-404 | Advanced Algorithms | CC | 3 | 0 | 0 | 3 |
| 5 | CSC-405 | Professional Communication | CC | 2 | 0 | 0 | 2 |
| 6 | CSC-406 | Artificial Intelligence Lab | CC | 0 | 0 | 2 | 1 |
| 7 | CSC-407 | Advanced Algorithms Lab | CC | 0 | 0 | 2 | 1 |
| 8 | CSC-408 | Programming Language Lab | CC | 0 | 0 | 4 | 2 |
| 9 | CSC-481 | Society | AECC | 0 | 0 | 2 | 1 |
| Total | | | | | | | 21 |

**Semester – VIII**

| **S. No.** | **Course Code** | **Course Title** | **Type of Course (CC/EC)** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|---|---|---|
| 1 | CSC-409 | Neural Networks | CC | 3 | 0 | 0 | 3 |
| 2 | CSC-410 | Machine Learning | CC | 3 | 0 | 0 | 3 |
| 3 | CSC-411 | Combinatorial Optimization | CC | 4 | 0 | 0 | 4 |
| 4 | | Elective-V | EC | 4 | 0 | 0 | 4 |
| 5 | | Elective-VI | EC | 3 | 0 | 0 | 3 |
| 6 | CSC-412 | Research Seminar | CC | 0 | 2 | 0 | 1 |
| 7 | CSC-413 | Neural Networks Lab | CC | 0 | 0 | 2 | 1 |
| 8 | CSC-414 | Machine Learning Lab | CC | 0 | 0 | 2 | 1 |
| 9 | CSC-482 | Fitness | AECC | 0 | 0 | 2 | 1 |
| Total | | | | | | | 21 |

**Semester – IX**

| **S. No.** | **Course Code** | **Course Title** | **Type of Course (CC/EC)** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|---|---|---|
| 1 | CSC-501 | Data Mining | CC | 3 | 0 | 0 | 3 |
| 2 | CSC-502 | Information Retrieval and Web search | CC | 4 | 0 | 0 | 4 |
| 3 | CSC-503 | Soft Computing | CC | 3 | 0 | 0 | 3 |
| 4 | | Elective-VII | EC | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | | Elective-VIII | EC | 3 | 0 | 0 | 3 |
| 6 | CSC-504 | Mini Project | CC | 0 | 0 | 4 | 2 |
| 7 | CSC-505 | Data Mining Lab | CC | 0 | 0 | 2 | 1 |
| 8 | CSC-506 | Soft Computing Lab | CC | 0 | 0 | 2 | 1 |
| Total | | | | | | | 20 |

**Semester – X**

| S. No. | Course Code | Course Title | Type of Course (CC/EC) | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CSC-507 | Project Work in Industry or Institution (16 week) | CC | 0 | 20 | 20 | 20 |
| Total | | | | | | | 20 |

## List of Electives:

| Third Year | | Fourth Year | | Fifth Year | |
|---|---|---|---|---|---|
| **Subject Code** | **Subject Title** | **Subject Code** | **Subject Title** | **Subject Code** | **Subject Title** |
| CSC-331 | Computer Graphics | CSC-431 | Web Technologies | CSC-531 | Programming in Java |
| CSC-332 | Internet Technologies | CSC-432 | Cloud Computing | CSC-532 | Dot Net Technologies |
| CSC-333 | E-Commerce | CSC-433 | Grid Computing | CSC-533 | Compiler Design |
| CSC-334 | Open-Source Operating System | CSC-434 | Ad-hoc Networks | CSC-534 | Computing for Data Science |
| CSC-335 | Discrete Structure | CSC-435 | Digital Image Processing | CSC-535 | Software Defined Networks |
| CSC-336 | Information Security | CSC-436 | Parallel Processing | CSC-536 | Mobile Computing |
| | | CSC-437 | Natural Language Processing | CSC-537 | Human Computer Interaction |
| | | CSC-438 | High Performance Computing | CSC-538 | Fractal Theory |
| | | CSC-439 | Game Theory | CSC-539 | Software Agents and Swarm Intelligence |
| | | | | CSC-540 | Internet of Things |

## Program Outcomes

PO1: To develop strong foundation in basic sciences useful in higher studies/ competitive examinations.

PO2: To inculcate values and ethics for character building of individual.

PO3: To have a basic proficiency in a traditional computer languages to make students to be able to write simple to intermediate programs and an ability to understand codes written in that languages.

PO4: Design, analyze and solve problems in different domains like programming, networking, database and computer hardware design.

PO5: Apply standard software engineering process and strategies in software project development using open source programming environment to solve the real-world issues.

PO6: To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.

PO7: Develop an understanding of how artificial intelligence algorithms and technologies are designed, developed, optimized and applied to meet business objectives.

PO8: Learn to use a range of software systems that can be used to build reliable, scalable and quality artificial intelligence solutions, and how to apply rigorous AI methodologies through experimental design and exploratory modelling.

PO9: Acquaintance with latest trends in technological development and thereby innovate new ideas and solutions to existing problems.

PO10: Get some development experience within a specific field of Computer Science, through project work.

PO11: Apply creativity, critical thinking, analysis and research skills.

PO12: Designing and delivering an effective presentation in academic and professional work.

PO13: To prepare for placement by improving communication skills and team work, ability to participate in debates, and discussions in the society constructively.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSC-101 Computer Fundamentals & Programming in C | | | | 3 | | | | | | | | | |
| CSC-102 C Programming Lab | | | 3 | | | | | | | | | | |
| EN-101 Language and Communication Skills | | | | | | | | | | | | 3 | 2 |
| IMM-112 Calculas I | 3 | | | | | | | | | | 1 | | |
| Two Electives (Physics/ Chemistry/ Stats/ Economics) | 3 | | | | | | | | | | 1 | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSC-103 Object Oriented Programming in C++ | | | | 3 | | | | | | | | | |
| CSC-104 C++ Programming Lab | | | 3 | | | | | | | | | | |
| CSC-105 ICT Lab | | | | | | | | | | | | 3 | |
| IMM-122 Calculas II | 3 | | | | | | | | | | 1 | | |
| Two Electives (Physics/ Chemistry/ Stats/ Economics) | 3 | | | | | | | | | | 1 | | |
| CSC-201 Data Structures | | | | 3 | | | | | | | | | |
| CSC-202 Data Structure Lab | | | | | 3 | | | | | | | | |
| EVS-201 Environmental Studies | | 3 | | | | | | | | | | | |
| PA-301 Introduction to Public Administration | | 3 | | | | | | | | | | | |
| Two Electives (Physics/ Chemistry/ Stats/ Economics) | 3 | 1 | | | | | | | | | 1 | | |
| CSC-203 Database Management System | | | | 3 | | | | | | | | | |
| CSC-204 Database Management Lab | | | | | 3 | | | | | | | | |
| Elective (Science/ Social Science) | | 3 | | | | | | | | | 1 | | |
| Two Electives (Maths/ Physics/ Chemistry/ Stats/ Economics) | 3 | 1 | | | | | | | | | 1 | | |
| CSC-301 Computer Networks | | | | 3 | 1 | | | | | | | | |
| CSC-302 Operating System | | | | 3 | 3 | | | | | | | | |
| CSC-303 Software Engineering | | | | 3 | 3 | | | | | | | | |
| Open Elective of Science Stream | 1 | | | 3 | 3 | | | | | | | | |
| Elective (Non-Science) | | 3 | | | | | | | | | 1 | | |
| CSC-304 Design & Analysis of Algorithms | | | | 3 | 3 | | | | | | | | |
| CSC-305 Theory of Computation | | | | 3 | | | | | | | | | |
| CSC-306 Computer Systems | | | | 3 | | | | | | | 1 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Architecture | | | | | | | | | | | | | |
| CSC-307 Project + Seminar | | | | | | | | | | 3 | | 2 | 3 |
| Open Elective of Science Stream | 1 | | | 3 | | | | | | | | | |
| Elective (Non-Science) | | 3 | | | | | | | | | 1 | | |
| CSC-401 Introduction to Artificial Intelligence | | | | | | | 3 | | | | | | |
| CSC-402 Logic in AI | | | | | | | 1 | | | | 3 | | |
| CSC-403 Probability & Statistics | | | | | | | 1 | | | | 3 | | |
| CSC-404 Advanced Algorithms | | | | | | | 2 | 1 | | | 3 | | |
| CSC-405 Professional Communication | | | | | | | | | | | | 3 | 3 |
| CSC-406 Artificial Intelligence Lab | | | | | | 3 | | | | | | | |
| CSC-407 Advanced Algorithms Lab | | | | | | | | 3 | | | | | |
| CSC-408 Programming Language Lab | | | | | | 2 | | 3 | 3 | | | | |
| CSC-409 Neural Networks | | | | | | | 3 | | 3 | | 2 | | |
| CSC-410 Machine Learning | | | | | | | 3 | | 3 | | 3 | | |
| CSC-411 Combinatorial Optimization | | | | | | | 3 | | | | 3 | | |
| CSC-412 Research Seminar | | | | | | | | | | | | 3 | 2 |
| CSC-413 Neural Networks Lab | | | | | | | | 3 | | | | | |
| CSC-414 Machine Learning Lab | | | | | | | | 3 | | | | | |
| CSC-501 Data Mining | | | | | | 3 | 3 | | 3 | | 3 | | |
| CSC-502 Information Retrieval and Web search | | | | | | | 3 | | 3 | | 3 | | |
| CSC-503 Soft Computing | | | | | | | 3 | | 3 | | 3 | | |
| CSC-504 Mini Project | | | | | | | | | 2 | 3 | | 2 | 2 |
| CSC-505 Data Mining Lab | | | | | | | | 3 | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSC-506 Soft Computing Lab | | | | | | | | 3 | | | | | |
| CSC-507 Project Work in Industry or Institution | | | | | | | | | 3 | 3 | 2 | 2 | 1 |
| Electives (1, 2, 3, 4) | | | | | | | | | 3 | | 3 | | |

# Detailed Syllabus

### CSC-101: Computer Fundamentals & Programming in C

**Course Outline:** Basic understanding of computer fundamentals and various types of languages. Various kinds of number representation and flow chart for easy understanding flow of an algorithm. C-language basics, control and looping control structures.

**UNIT – I:** Introduction to Computer, Von Neumann Architecture, Generation of Computer, Storage Device- Primary Memory and Secondary Storage, Random, Direct, Sequential access methods. Concept of High-Level, Assembly and Low Level programming languages, Program Development Steps, Representing Algorithms through flow chart, pseudo code.
Binary Codes: Binary arithmetic, Addition and subtraction of Integers and floating point numbers. Multiplication of Integers. Gray code, BCD, Excess-3 and Excess-3 gray codes,
Concept of radix and representation of numbers in radix r with special cases of r=2, 8, 10 and 16 with conversion from radix r1 to radix r2. r's and (r-1)'s complement. Representation of Integer in sign-magnitude, signed 1's and 2's complement
**UNIT-II :** Structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation.
Input-output statements, statements and blocks, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels, programming examples.
**UNIT-III:** Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, example c programs.
**UNIT – IV:** Introduction to Arrays- concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. String and String functions.
Derived types- structures- declaration, definition, Pointers- concepts, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays

**Text/Reference Books**

1. Ritchie & Kernighan, The C Programming language, ANSI C Version 2nd Ed., PHI.
2. P. Dey, N. Ghosh, Computer Fundamentals and programming in C, 1st Edition, 2006 Oxford University Press
3. Ashok Kamthane, Programming in C, 2nd Ed., Pearson 2011
4. Schildt, C- The Complete Reference, 4th Ed., TMH 2000
5. E. Balaguruswamy, Programming in ANSI C, 6th Ed., TMH 2012
6. V. Rajaraman, Fundamentals of Computers, 5th Ed. PHI, 2011.
7. P.K. Sinha (Fundamental of Computers) 6th Edition BPB Publications 2003

**Course Outcomes:**

1. To learn the basic principles of programming and software development.
2. To demonstrate the use of various structured Programming concepts with the help of programs.
3. To enhance problem-solving and programming skills in C.

| CSC-101 Computer Fundamentals & Programming in C | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | | | | 3 | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | |

## CSC-102 C Programming Lab

**Course Outcomes:**

1. Learning logics and programming in 'C' Language.

| CSC-102 C Programming Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | | | | | | |

## CSC-103: Object Oriented Programming in C++

**COURSE OUTLINE**

This course provides in-depth coverage of object-oriented programming principles and techniques using C++. The course begins with a brief review of control structures and data types with emphasis on structured data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design. Other topics include overloading, data abstraction, information hiding, encapsulation, inheritance, and polymorphism.

**Prerequisites**

- Experience with C language is a prerequisite.

**Objectives:**

The course is designed to provide complete knowledge of Object Oriented Programming through C++ and to enhance the programming skills of the students by giving practical assignments to be done in labs. The following are the main objectives of this course:

- To learn advanced features of the C++ programming language as a continuation of C programming.
- To learn the basic principles of object-oriented design and software engineering regarding software reuse and managing complexity.
- To demonstrate the use of various OOPs concepts with the help of programs.
- To enhance problem-solving and programming skills in C++.

**UNIT I:** Introduction to programming paradigms- (Process oriented and Object oriented).
Concept of object, class, objects as variables of class data type, difference in structures and class in terms of access to members, private and public members of a class, data & function members. Characteristics of OOP- Data hiding, Encapsulation, data security.

**UNIT II:** Basics of C++: Structure of C++ programs, introduction to defining member functions within and outside a class, keyword *using*, declaring class, creating objects, constructors & destructor functions, Initializing member values with and without use of constructors, simple programs to access & manipulate data members, *cin* and *cout* functions. Dangers of returning reference to a private data member, constant objects and members function, composition of classes, friend functions and classes, using *this* pointer, creating and destroying objects dynamically using *new* and *delete* operators. Static class members, container classes and iterators, proxy classes

**UNIT III:** Operator overloading: Fundamentals, Restrictions, operator functions as class members v/s as friend functions. Overloading stream function, binary operators and unary operators. Converting between types.

**UNIT IV:** Inheritance: Base classes and derived classes, protected members, relationship between base class and derived classes, constructors and destructors in derived classes, public, private and protected inheritance, relationship among objects in an inheritance hierarchy, abstract classes, virtual functions and dynamic binding, virtual destructors.

Multiple inheritance, virtual base classes, pointers to classes and class members, multiple class members. Templates, exception handling.

**Text/ References**


1. E. Balagurusamy, Object Oriented Programming with C++, 5th Edition, TMH Education 2011
2. Robert Lafore, Object Oriented Programming, Pearson Publication 2008
3. Rajesh Kumar Shuka, Wiley Publication, 2008
4. Bjarne Stroustrup, The C++ Programming Language, 3rd Edition, Pearson Publication 2002


**Course Outcomes:**

1. To learn advanced features of the C++ programming language as a continuation of C programming.
2. To learn the basic principles of object-oriented design and software engineering regarding software reuse and managing complexity.
3. To demonstrate the use of various OOPs concepts with the help of programs.
4. To enhance problem-solving and programming skills in C++.

| CSC-103 Object Oriented Programming in C++ | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | | | | | | | | | |
| CO2 | | | | 3 | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | |
| CO4 | | | | 3 | | | | | | | | | |

## CSC-104 C++ Programming Lab

Course Outcomes:

1. Implementation of Object – Oriented Modelling in 'C++'

| CSC-104 C++ Programming Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | | | | | | |

## CSC-201: Data Structures

**COURSE OUTLINE**

The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, recursion, stack, queue, heaps, sorting algorithms, and binary tree.

**Prerequisites**

- Experience with C language is a prerequisite.

**Objectives:**

- To impart the basic concepts of data structures and algorithms.
- To introduce various techniques for the representation of the data in the real world.
- To understand basic concepts about the array, stacks, queues, lists, and trees.
- To understand concepts about searching and sorting techniques.
- To understanding writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

**UNIT I:** Arrays: Array as storage element, Row major & column major form of arrays, computation of address of elements of n dimensional array. Arrays as storage elements for representing polynomial of one or more degrees for addition & multiplication, sparse matrices for transposing & multiplication

**UNIT II :** Stack, queue, dequeue, circular queue for insertion and deletion with condition for over and underflow, transposition of sparse matrices with algorithms of varying complexity

**UNIT III:**Linear linked lists: singly, doubly and circularly connected linear linked lists insertion, deletion at/ from beginning and any point in ordered or unordered lists. Comparison of arrays and linked lists as data structures.
Linked implementation of stack, queue and dequeue. Algorithms for/of insertion, deletion of stack, queue, dequeue implemented using linked structures. Polynomial representation using linked lists for addition, Concepts of Head Node in linked lists.
Searching: Sequential and binary search.

**UNIT IV:**Non-Linear Structures: Trees definition, characteristics concept of child, sibling, parent child relationship etc, binary tree: different types of binary trees based on distribution of nodes, binary tree (threaded and unthreaded) as data structure, insertion, deletion and traversal of binary trees, constructing binary tree from traversal results. B-Trees and introduction to B+ Trees. Graph, Traversersing

**Text/References:**


1. An introduction to data structures with applications By Jean-Paul Tremblay, P. G. Sorenson, TMH
2. A. Drozdek, Data Structures and Algorithms in C++, 3rd Edition, Course Technology
3. Data Structures in C & C++, Tanenbaum, PHI
4. S. Sahni, Data Structure Algorithms and Applications in C++, Wiley 2003.


**Course Outcomes:**

1. To impart the basic concepts of data structures and algorithms.
2. To introduce various techniques for the representation of the data in the real world.
3. To understand basic concepts about the array, stacks, queues, lists, and trees.
4. To understand concepts about searching and sorting techniques.
5. To understanding writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

| CSC-201 Data Structures | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | | | | | | | | | |
| CO2 | | | | 3 | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | |
| CO4 | | | | 3 | | | | | | | | | |
| CO5 | | | | 3 | | | | | | | | | |

## CSC-202 Data Structure Lab

**Course Outcomes:**

1. Implementation of Data Structure concepts and algorithms in 'C'

| CSC-202 Data Structure Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | 3 | | | | | | | | |

## CSC-203: Database Management System

**Prerequisites to course:**

- Object oriented and GUI programming
- Problem solving and structured programming

**Objectives:**

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS. Also provide fundamental knowledge of, and practical experience with, database concepts. Include study of information concepts and the realization of those concepts using the relational data model. Practical experience gained designing and constructing data models and using SQL to interface to user DBMS packages.

**UNIT-I:** Introduction to database, Overview and History of DBMS, File System vs DBMS, Purpose of Database, Overall System Structure, Entity Relationship Model, Mapping Constraints - Keys - E-R Diagrams.

**UNIT-II:** Overview of Data Design Entities, Attributes and Entity Sets, Relationship and Relationship Sets, Features of the ER Model-Key Constraints, Participation Constraints, Weak Entities, Class Hierarchies, Aggregation.
Relationship Algebra: Selection and Projection, Set Operations, Renaming, Joints, Division, Relation Calculus.

**UNIT-III:** Relational Database Design: Pitfalls, Normalization Using Functional, Dependencies, First Normal Form, Second Normal Form, Third Normal Form and BCNF.

**UNIT-IV:** Structured Query Language (SQL), Basic Structure, Set Operations, Aggregate, Functions, Date, Numeric, and Character Functions, Nested Sub queries, Modification of Databases, Joined Relations.
Transaction Processing: ACID Properties, Concurrency Control, Recovery.

**Text/References:**

1. Elmasri R and Navathe SB, Fundamentals of Database Systems, 3rd Edition, Addison Wesley, 2000.
2. Connolly T, Begg C and Strachan A, Database Systems, 2nd Edition, Addison Wesley, 1999
3. Ceri Pelagatti , Distributed Database: Principles and System - (McGraw Hill)
4. Simon AR, Strategic Database Technology: Management for the Year 2000, Morgan Kaufmann, 1995
5. A. Silversatz, H. Korth and S. Sudarsan: Database Cocepts 5th edition, Mc-Graw Hills 2005.

**Course Outcomes:**

1. The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.
2. Also provide fundamental knowledge of, and practical experience with, database concepts.
3. Include study of information concepts and the realization of those concepts using the relational data model.
4. Practical experience gained designing and constructing data models and using SQL to interface to user DBMS packages.

| CSC-204 Database Management Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | | | | | | | | | |
| CO2 | | | | 3 | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | |
| CO4 | | | | 3 | | | | | | | | | |

## CSC-204 Database Management Lab

**Course Outcomes:**

1. Implementation of DBMS fundamentals in MySQL

| CSC-204 Database Management Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | 3 | | | | | | | | |

# V Semester

## CSC-301: Computer Networks

**Course outline:** The designed course covers the topics of computer networks covers the fundamentals of computer networks , basics of signals , convention of signals from analog to digital and from digital to analog. Course will give introduction of OSI Model for computer communication system and practical explore of communication protocol model which is TCP/IP layer architecture. Course will cover detail functionalities and basic services provided by each and every layer.

**Objectives of the Course: -**

- The course demonstrates OSI and TCP/IP Model.
- Clear understanding of Guided Media characteristics and various Network Topology and Hardware building blocks.
- Demonstration of challenges and issues in Data Link Layer functionalities.
- Demonstration and Explanation of routing algorithms in Network Layer.
- Demonstration of Various Application layer concepts.

**UNIT I:** Introduction to Networks and Layered Architectures (OSI, TCP/IP), Categories of Networks Network performance measures e.g. bandwidth, latency, Delay/bandwidth product. Transmission Media: Guided Media (twisted pair cable, Coaxial Cable, fibre optic cable), Unguided media (radio waves, microwaves, infrared), Topology. Hardware building Blocks of a network e.g. switches, routers, gateways etc.

**UNIT II:** Data Link Layer: Data Link Layer Design Issues - Error Detection and Correction. Elementary data link protocols - Sliding Window Protocols - Protocols Verification - Channel Allocation Problem- Multiple Access Protocols

**UNIT III:** Network Layer: Network Layer Design Issues- Routing Algorithms-Congestion Control Algorithms- Quality of Service -Internetworking
Transport Layer: Transport Services – elements of transport protocols – simple transport protocols.

**UNIT IV:** Application layers: Domain name system – Electronic mail – The World Wide Web. Introduction to Network security.

**Text/References:**


1. Computer Networks, Andrew S. Tanenbaum , Fourth edition,PHI private Ltd, New Delhi , 2008
2. Computer Networking Top Down approach 3rdeditionBy Jim kurose and keithross


**Course Outcomes:**

1. The course demonstrates OSI and TCP/IP Model.
2. Clear understanding of Guided Media characteristics and various Network Topology and Hardware building blocks.
3. Demonstration of challenges and issues in Data Link Layer functionalities.
4. Demonstration and Explanation of routing algorithms in Network Layer.
5. Demonstration of Various Application layer concepts.

| CSC-301 Computer Networks | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | | | 3 | 1 | | | | | | | | |

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| CO2 | | | | 3 | 1 | | | | | | | | |
| CO3 | | | | 3 | 1 | | | | | | | | |
| CO4 | | | | 3 | 1 | | | | | | | | |
| CO5 | | | | 3 | 1 | | | | | | | | |

## CSC-302: Operating System

Operating systems are the heart of the Computer system. They act as an interface between the Hardware and the user. This course is designed to provide in-depth understanding of the operating systems.

**Course Objectives**

- Provide basic understanding of the functions and types of operating systems.
- To introduce the concepts of process management, memory management, file management and deadlocks.
- Do practical exercises on scheduling techniques.
- Laboratory exercises to be covered in Lab sessions.

**UNIT-I:** Introduction to Operating Systems, Types of operating systems, Multiprogramming, Time-sharing systems, Operating system services, System calls and System programs, Storage structures

**UNIT II:** Process concepts, process scheduling, operations on process, threads, Inter process communication, precedence graphs, critical section problem, semaphores, classical problems of synchronization, CP Scheduling.

**UNIT-III:** Memory Management, Single and multiple partitioned allocations, paging segmentation, Virtual Memory Management, Demand paging and Page Replacement Algorithms

**UNIT-IV:** Deadlock: Introduction, problem, characterization, prevention, avoidance, detection, recovery from deadlock, Methods for deadlock handling.
File concept, Access methods, Directory structure, allocation methods, free space management, disk scheduling,

**Text/References:**

1. Abraham Silberschatz and P. B. Galvin - Operating system concepts – Addison Wesley Publication
2. A. Tanunbaum, Modern Operating Systems, 3rd Edition, Pearson Publication

**Course Outcomes:**

1. Provide basic understanding of the functions and types of operating systems.
2. To introduce the concepts of process management, memory management, file management and deadlocks.
3. Do practical exercises on scheduling techniques.
4. Laboratory exercises to be covered in Lab sessions.

| CSC-302 Operating System | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | 3 | | | | | | | | |
| CO2 | | | | 3 | 3 | | | | | | | | |
| CO3 | | | | 3 | 3 | | | | | | | | |
| CO4 | | | | 3 | 3 | | | | | | | | |

# CSC-303: Software Engineering

**Prerequisites to course:** Data base management system & operating system.

**Objectives:-** The Software Engineering course provides students with knowledge and skills that enable them to design, code, test and manage quality-measured software systems. Software Engineering major includes studying and practicing the software development process, in addition to the algorithm and data process needed to develop innovative software that solves a specific problem.

- Knowledge of basic SW engineering methods and practices, and their appropriate application.
- A general understanding of software process models such as the waterfall and evolutionary models.
- Understanding of software requirements and the SRS documents.
- Understanding of software testing approaches such as unit testing and integration testing.
- Understanding on quality control and how to ensure good quality software.

**UNIT I:** System Analysis: Characteristics, Problems in system Development, System Level project Planning, System Development Life cycle (SDLC), computer system engineering & system analysis, modeling the architecture, system specification. Capability Maturity Model Integration (CMMI)
**UNIT II:** Requirement Analysis: Requirement analysis tasks, Analysis principles, Software prototyping and specification data dictionary finite state machine (FSM) models.
Structured Analysis: Data and control flow diagrams, control and process specification behavioural modelling, extension for data intensive applications.
**UNIT III:** Software Design: Design fundamentals, Effective modular design: Data architectural and procedural design, design documentation, coding – Programming style, Program quality, quantifying program quality, complete programming example
**UNIT IV:** Testing Strategies and tactics: Testing fundamentals, strategic approach to software testing, Validation testing, system testing, Black-Box testing, white-box testing and their types, basic path testing.

**Text/Reference Books**


1. R.S. Pressman, Software Engineering: A Practitioner's Approach, Mc Graw Hill
2. P. Jalote, An Integrated Approach to Software Engineering (II Edition)
3. KK Agarwal an Y. Singh, Software Engineering, New Age International Publishers
4. I. Somerville, Software Engineering, Addison Wesle, 2006


**Course Outcomes:**

1. The Software Engineering course provides students with knowledge and skills that enable them to design, code, test and manage quality-measured software systems. Software Engineering majorly includes studying and practicing the software development process, in addition to the algorithm and data process needed to develop innovative software that solves a specific problem.
2. Knowledge of basic SW engineering methods and practices, and their appropriate application.
3. A general understanding of software process models such as the waterfall and evolutionary models.
4. Understanding of software requirements and the SRS documents.
5. Understanding of software testing approaches such as unit testing and integration testing.
6. Understanding on quality control and how to ensure good quality software.

| CSC-303 Software Engineering | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | | | 3 | 3 | | | | | | | | |
| CO2 | | | | 3 | 3 | | | | | | | | |
| CO3 | | | | 3 | 3 | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | | | | 3 | 3 | | | | | | | | |
| CO5 | | | | 3 | 3 | | | | | | | | |
| CO6 | | | | 3 | 3 | | | | | | | | |

## Open Elective of Science Stream

**Course Outcomes:**

1. To make the students learn about different streams of Science

| Open Elective of Science Stream | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | 3 | 3 | | | | | | | | |

## Elective (Non-Science)

**Course Outcomes:**

1. To get acquaintance with arts subjects.

| Elective (Non-Science) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | 3 | | | | | | | | | 1 | | |

# VI Semester

## CSC-304: Design & Analysis of Algorithms

**Outline of the Course:-**

The proposed DAA course covers algorithm and its design strategies. The course will illustrate complexity of designed algorithm in space and time of algorithms. Various Asymptotic notations illustrated during the course. Designed strategies have explained by taking well known algorithms, NP-Complete and NP-Hard topic explained.

**Objectives:**

- Demonstrate various algorithm analysis parameters to explain best, average and worst case.
- Various strategies to explain to design algorithms.
- Demonstration of various Graph Theory algorithms such as Minimal Spanning Tree and All pair shortest Path.
- Demonstration of P and NP Complete Problems.

**UNIT I:** Definition & characteristics of algorithms, structures. Difficulties in estimating exact execution time of algorithms. Concept of complexity of program. Asymptotic notations: Big-Oh, theta, Omega- Definitions and examples, Determination of time and space complexity of simple algorithms without recursion. Representing a function in asymptotic notations.

**UNIT II:** Divide-and-conquer, Dynamic Programming, Greedy methods, Backtracking, Branch-and Bound Technique.

**UNIT III:** Minimum Spanning Trees, Single-Source Shortest Paths, All-Pairs Shortest Paths, Maximum Flow. String Matching, Computational Geometry.

**UNIT IV:** P and NP class, NP-completeness and reducibility, NP-complete problems.

**Text/References:**

1. T. Cormen, C. Leiserson, R. Rivest. Introduction to Algorithms, Indian Reprint, PHI
2. V. Aho, J. Hopcraft, J. Ulmann. The Design and analysis of computer Algorithms. Addison Wesley
3. S. Basse, A. V. Gelder, Computer Algorithms: Introduction to design and Analysis, 3rd., Pearson Education Asia Pvt. Ltd.

**Course Outcomes:**

1. Demonstrate various algorithm analysis parameters to explain best, average and worst case.
2. Various strategies to explain to design algorithms.
3. Demonstration of various Graph Theory algorithms such as Minimal Spanning Tree and All pair shortest Path.
4. Demonstration of P and NP Complete Problems.

| CSC-304 Design & Analysis of Algorithms | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | 3 | | | | | | | | |
| CO2 | | | | 3 | 3 | | | | | | | | |
| CO3 | | | | 3 | 3 | | | | | | | | |
| CO4 | | | | 3 | 3 | | | | | | | | |

## CSC-305: Theory of Computation

**Prerequisites to course:**

- Discrete structures and graph theory.
- Mathematical background.

**Course Outline:**

The proposed Course theory of computation illustrates various computational models to perform scientific calculations. The proposed model describes how to design mathematical function which admits an algorithm. In the proposed course one of the functions which are membership to find an element belongs to set different classes of set or not. The proposed course describes various kind of automata which are mathematical models to accept or reject sentences belongs to various kinds of formal languages.

**Objectives:**

- Design various kinds of mathematical models to perform computing strategies.
- Demonstrate the various kinds of automata models to accept or reject strings belong to the various kinds of formal languages.
- To identify the limitation of the proposed model and try to find the models overcome the limitations.
- Understand various design principles of the computing models to estimate functioning of models.
- Decide a function admits an algorithm or not, if it admits a function then develop a step by step procedure.
- Learn Mathematical models and formal languages to develop compiler various phases such as lexical phase and syntax phase.
- Basic understanding of Finite Automata, Push down Automata and Turing Machine Design.

- Various forms to represent the formal languages and simplification of grammar.

**UNIT I:** Languages: Alphabets, string, language, basic operations on language, concatenation, Kleene Star
**UNIT II:** Regular languages model: finite state machine (deterministic and non deterministic), regular grammars, regular expressions, equivalence of deterministic and non deterministic machine and of the three models; Properties: closure, decidability, minimality of automata.
**UNIT III:** Context Free Grammar, Derivation trees, Simplification of Context Free Grammar, Chomosky Normal Form, Greibach Normal Form, pushdown automata and their equivalence, Properties of Context Free Languages.
**UNIT IV:** Turing machines, grammars, recursive functions and their equivalence, language acceptability, decidability, halting problem
**Text/References:**
1. Hofcroft J.E., Ullman J.D., Introduction to Automata Theory, Languages and Computation, Narosa Publishing House.
2. Lewis H. R. and Papadimitriou C. H., Elements of the theory of computation, Pearson Education Asia
3. Martin J. C., Introduction to Languages and the Theory of Computation, 2e, Tata McGraw-Hill .
4. Daniel I A Cohen, Introduction to computer Theory, Wiley II Edition

**Course Outcomes:**

1. Design various kinds of mathematical models to perform computing strategies.
2. Demonstrate the various kinds of automata models to accept or reject strings belong to the various kinds of formal languages.
3. To identify the limitation of the proposed model and try to find the models overcome the limitations.
4. Understand various design principles of the computing models to estimate functioning of models.
5. Decide a function admits an algorithm or not, if it admits a function then develop a step by step procedure.
6. Learn Mathematical models and formal languages to develop compiler various phases such as lexical phase and syntax phase.
7. Basic understanding of Finite Automata, Push down Automata and Turing Machine Design.
8. Various forms to represent the formal languages and simplification of grammar.

| CSC-305 Theory of Computation | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | | | 3 | | | | | | | | | |
| CO2 | | | | 3 | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | |
| CO4 | | | | 3 | | | | | | | | | |
| CO5 | | | | 3 | | | | | | | | | |
| CO6 | | | | 3 | | | | | | | | | |
| CO7 | | | | 3 | | | | | | | | | |
| CO8 | | | | 3 | | | | | | | | | |

## CSC-306: Computer Systems Architecture

**Outline of the Course: -**
The outline of the course is basic understand of circuit logic design and storage information in various formats in the memory, various addressing modes and various registers.

**Course objectives:**
The course is designed to train the graduates in:

- Architecture of digital computers.

- Architecture of various digital units of a computer.
- Usage of digital computers in industry and research.

**UNIT I**
Digital Logic, Number Systems & codes, Computer Arithmetic: Logic Gates, Boolean Algebra Adder: Half Adder, Full Adder, Flip-flops: S-R, D, J-K and T- Flip Flop.

**UNIT II**
Digital Component: Multiplexer, Decoder, Encoder, Registers: Shift Register, Counters, Floating Point Arithmetic: Floating point representation, Add, Subtract, Multiplication, Division.

**UNIT III**
Register Transfer and Micro-operation: Register Transfer, Bus and Memory Transfers, Arithmetic Micro-operation: Binary Adder, Binary Adder Sub tractor and Binary Incremental, Micro-Operations: Logic and Shift, Instruction life cycle.

**UNIT IV**
Central Progressing Unit (CPU): General Register Organization, Control Word, Example of Micro operation, Stack Organization: Register stack, Memory Stack, Reverse Polish Notation. Instruction Formats, Three, Two, One, Zero Address Instructions, RISC Instructions, Addressing Modes, CISC Characteristics and RISC Characteristics.

**Text/References:**


1. Computer System Architecture- M. Morris Mano, Pearson Publication 3rd Edition, PHI
2. Computer Organizations and Architecture - William Stallings (Pearson Education Asia), 2008
3. Computer Organization and Architecture -John P. Hayes (McGraw -Hill), 1998
4. Computer Organization -V. Carl. Hamacher (McGraw-Hill), 2011
5. Nicolas Carter, Computer Architecture, Schaum's Series, TMH


**Course Outcomes:**

1. Architecture of digital computers.
2. Architecture of various digital units of a computer.
3. Usage of digital computers in industry and research.

| CSC-306 Computer Systems Architecture | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | | | 3 | | | | | | | 1 | | |
| CO2 | | | | 3 | | | | | | | 1 | | |
| CO3 | | | | 3 | | | | | | | 1 | | |

## CSC-307 Project + Seminar

**Course Outcomes:**

1. To apply the concepts learned in developing a small software and learn to present the software.

| CSC-307 Project + Seminar | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | | | | | | | | | 3 | | 2 | 3 |

## Open Elective of Science Stream

**Course Outcomes:**

1. To make the students learn about different streams of Science

| Open Elective of Science Stream | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | 1 | | | 3 | | | | | | | | | |

## Elective (Non-Science)

**Course Outcomes:**

1. To get acquaintance with arts subjects.

| Elective (Non-Science) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
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| CO1 | | 3 | | | | | | | | | 1 | | |

# VII Semester

### CSC-401: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

**Prerequisites to course:** Discrete Mathematics, Software Engineering.

**Objectives & Outline of the course: -**

The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning. Students will implement a small AI system in a team environment. The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.

1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.
2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs.
3. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

**UNIT 1: Introduction:** Introduction to AI, Historical Development, Turing Test. Problem Solving, Search Algorithms, State-space and Solution Space Search, State space as graph- state v/s node; Evaluating Search Strategies- Time, Space, Completeness, Optimality.
**Uninformed search:** Breadth First Search, Depth First Search, Iterative Deepening Search, Bi-directional Search, Uniform Cost Search.
**UNIT 2: Informed search:** Best First Search, Heuristic Search, A* Search, Admissible heuristic, Consistent heuristic, optimality and admissibility, IDA* search, Weighted A* search and inconsistency. Hill Climbing, Local Search, Simulated Annealing, local beam search and Genetic Algorithm.
**Adversarial search:** Adversarial Search and Game Playing, Min-max Algorithm, Alpha-beta pruning, partially observable games, stochastic games.

**UNIT 3: Constraint satisfaction problems:** Introduction to CSPs, Constraint Networks, Binary and non-binary constraints, qualitative and quantitative CSPs, Consistencies- Local and global consistencies; Constraint propagation and generalizations – Related Methods: backtracking search; dynamic programming; variable elimination; Handling Spatial and Temporal constraints.
**AI planning:** Introduction, complexity, PDDL, Domain Independent Planning, Domain Description, PDDL (syntax), forward vs. backward search, planning graph. Graph Plan,
**UNIT 4: Probabilistic reasoning:** Uncertainties in AI; Markov random fields; Markov networks; Baye's Theorem; Bayesian networks – Concepts, Representation and Inference; Hidden Markov Model and Dynamic Bayesian Network. Dempster-Shaffer Framework of Evidential Reasoning.

**BOOKS**

1. Artificial Intelligence: A Modern Approach (third Edition): S. Russel and P. Norvig.
2.Artificial Intelligence: Foundation of Computational Agents: D Poole and AMckworth.

**Course Outcomes:**

1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.
2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs.
3. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

| CSC-401 Introduction to Artificial Intelligence | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | | | | |
| CO2 | | 3 | | | | | | |
| CO3 | | 3 | | | | | | |

## CSC-402 LOGIC IN ARTIFICIAL INTELLIGENCE

**Objectives & Outline of the Course:**

After completion of this course students will be able to model a statement mathematically. The purpose of this course is to prepare strong mathematical foundation for the courses of Artificial Intelligence,

**UNIT 1:** Introduction to Logic; Classical logic: review of FOL and Propositional Logic; Logical agents. Propositional Logic: Wumpus World, Syntax and Semantic of Propositional Logic, Propositional Inference, Entailments, Truth Table Method, Normal Forms, Soundness, and Completeness. Implicates/implicates, Knowledge Compilation; Refutation Completeness SAT-Boolean Satisfiability; different approaches to SAT problems and its variants .

**UNIT 2:** First-Order Logic – inferences in First Order logic – forward chaining – backward chaining – unification – resolution. Knowledge representation concepts; entailment, inference, monotonicity, etc. Other Knowledge Representation Schemes.

**UNIT 3 :** Non-monotonic Logic and application of Non-monotonic Reasoning. Default Logic Modal Logic. Verification and Model Checking, Linear-Temporal Logic, program verification.

**UNIT 4:** Modal logics & application. Uncertainties in logic.

**BOOKS:**
1. Arindama Singh, Logic for Computer Science.

**Course Outcomes:**

1. After completion of this course students will be able to model a statement mathematically.
2. The purpose of this course is to prepare strong mathematical foundation for the courses of Artificial Intelligence.

| CSC-402 Logic in AI | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
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| CO1 | | 1 | | | | 3 | | |
| CO2 | | 1 | | | | 3 | | |
| CO3 | | 1 | | | | 3 | | |

## CSC-403: PROBABILITY AND STATISTICS

**Course Objectives**

- To provide students with a formal treatment of probability theory.
- To equip students with essential tools for statistical analyses.
- To foster understanding through real-world statistical applications.

**UNIT I:** Probability Theory: Axioms of Probability theory, Probability Spaces, Conditional Probability, random variables

**UNIT II:** Probability densities, joint densities, marginal densities, conditional densities Expectation and covariances, Bayesian probabilities, Gaussian distribution.

**UNIT III:** Decision theory, Introduction to information theory, Exponential family of distribution Nonparametric methods .

**UNIT IV:** Descriptive statistics, presentation of data, averages, measures of variation. Elementary probability, binomial and normal distributions. Sampling distributions. Statistical inference, estimation, confidence intervals, testing hypotheses, linear regression, and correlation.

**BOOKS**

1. Probability and Computing, by Michael Mitzenmacher and Eli Upfal, Cambridge University Press
2. Christopher M. Bishop. Pattern Recognition and Machine Learning, Springer, 2006. (For first two chapters)
3. Artificial Intelligence: A Modern Approach (third Edition): S. Russel and P. Norvig.

**Course Outcomes:**

1. To provide students with a formal treatment of probability theory.
2. To equip students with essential tools for statistical analyses.
3. To foster understanding through real-world statistical applications.

| CSC-403 Probability & Statistics | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 1 | | | | 3 | | |
| CO2 | | 1 | | | | 3 | | |
| CO3 | | 1 | | | | 3 | | |

## CSC-404: ADVANCED ALGORITHMS

**Course Outline:-**

Advanced Algorithm is seen as an imperical thoughts of design and analysis course which is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications

which cover several advanced topics like P,NP Complete problems, Btree, Fibonacci heaps, Disjoint sets, hashing, network design, algorithms in machine learning, internet algorithms, and nearest neighbor algorithms. It also boost various useful ideas, including randomization, probabilistic analysis, amortized analysis, competitive analysis, eigenvalues, high dimensional geometry, and random walks etc.

**Course objectives:**
The course is designed to train the graduates in:

- Advanced topics in algorithm.
- To develop concept, ideas for any problem.
- To be enable to formalize with theoretical computer algorithms.

**Course Contents:**

**Unit-I: Design Paradigms Overview**: Overview of complexity notations, Divide and Conquer method, Greedy and Dynamic Programming, Backtracking, Branch and Bound, Max Flow Problem, String Matching etc.

**Unit-II: Randomized Algorithms and Parallel Algorithms:** Randomized Algorithms: Las Vegas and Monte Carlo algorithms, Applications on graph problems, Finger Printing, Pattern Matching, Primality testing algorithm. Parallel Algorithms: Introduction, Models, speedup and efficiency, sorting, merging, and searching etc. in parallel, parallel sorting networks, Odd-Even, Bitonic etc.

**Unit-III: Approximation Algorithms:** Introduction, Combinatorial optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, subset-sum problem etc., Analysis of the expected time complexity of the algorithms.

**UNIT-IV: Theory of NP- Hard and NP-Complete Problems:**
Definitions of P, NP, NP-Hard and NP-Complete Problems, Optimization and Decision Problems, Reducibility, Cook's Theorem, Satisfiability problem, NP completeness reductions examples.

**Text/References:**
1. Introduction to Algorithms: T.H. Cormen, C.E.Leiserson and R.L. Rivest
2. Fundamentals of Algorithmics : G.Brassard and P.Bratley
3. Approximation Algorithms: Vijay V.Vazirani
4. Randomized Algorithms: R. Motwani and P.Raghavan
5. Parallel Computing: Theory and Practice: M. J. Quinn
6. Introduction to Parallel Computing: T. G. Lewis and H. El-Rewini

**Course Outcomes:**

1. Advanced topics in algorithm.
2. To develop concept, ideas for any problem.
3. To be enable to formalize with theoretical computer algorithms

| CSC-404 Advanced Algorithms | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 2 | 1 | | | 3 | | |
| CO2 | | 2 | 1 | | | 3 | | |

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| CO3 | | 2 | 1 | | | 3 | | |

## CSC-405 -PROFESSIONAL COMMUNICATION

**Outline**

The course has been designed keeping in mind the communicative needs of the students as lack of proficiency and fluency of students is one of the major barriers in getting employment in the job market.

**Objectives**

The objectives of the course are:

- to make the student proficient and fluent in speaking
- to enable the student to comprehend what is spoken and written
- to ensure that they become fast readers
- to make them handle basic correspondence effectively
- to enhance their vocabulary base

**Course Content:-**

Grammar and Vocabulary:Tenses, subject–verb agreement.Sentence Analysis: Simple, Compound and Complex sentences.Phrases: Adjective, Adverb and Noun Phrase, Clauses: Adjective, Adverb and Noun Phrase. Voice, Narration, Gerund, Participle.

Oral Communication:

Listening Skill – Active listening, Barriers to active listening**.** Speaking Skill-Stress patterns in English, Questioning skills, Barriers in Speaking**.** Reading Skill-Skimming, Scanning, Intensive reading, linking devices in a text, Different versions of a story/ incident**.**

Written communication:

Writing process, paragraph organization, writing styles.Types of Writing **-** Technical vs. creative; Types of technical writing, Scientific Writing:Writing a Scientific Report Soft Skills: Body Language– Gesture, posture, facial expression.

Group Discussion– Giving up of PREP, REP Technique.

Presentation Skills:

(i) How to make power point presentation (ii) Body language during presentation (iii) Resume writing:Cover letter, career objective, Resume writing (tailor made)

Interview Skills:Stress Management, Answering skills.

**BOOKS:**

1. Advanced English Usage: Quirk & Greenbaum; Pearson Education.
2. Developing Communication Skills: Banerjee Meera & Mohan Krishna; Macmillan Publications, 1990.
3. Business Communication: Chaturvedi, P.D.; Pearson Publications.
4. Business Communication; Mathew, M.J.; RBSA Publications, 2005.
5. Communication of Business; Taylor, Shirley; Pearson Publications.
6. Soft Skills: ICFAI Publication
7. Collins English Dictionary and Thesaurus, Harper Collins Publishers and Times
8. Longman Language Activator, Longman Group Pvt Ltd
9. Longman Dictionary of contemporary English, Longman
10. The new Penguin Dictionary – a set of dictionaries of abbreviations, spelling, punctuation, plain English, grammar, idioms, thesaurus, 2000.
11. New Oxford Dictionary.
12. Wren & Martin: High School English Grammar and Composition
13. Raymond Murphy: English Grammar in Use (4th edition)
14. Martin Hewings: Advanced Grammar in Use

15. Betty Schrampfer: Understanding and Using English Grammar

**Course Outcomes:**

1. to make the student proficient and fluent in speaking
2. to enable the student to comprehend what is spoken and written
3. to ensure that they become fast readers
4. to make them handle basic correspondence effectively to enhance their vocabulary base

| CSC-405 Professional Communication | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | 3 | 3 |
| CO2 | | | | | | | 3 | 3 |
| CO3 | | | | | | | 3 | 3 |
| CO4 | | | | | | | 3 | 3 |

## CSC-408: Programming Language (Credits 02)

**Any One of the following Language may be Chosen by the availability of the faculty. Python/Java/.NET Frame work /MATLAB/ any other programming Language.**

**Outline of the Course: -** Course Instructor can introduce any programming language based on interest of students and Instructor can design set of programs to cover the fundamentals the language chosen by the instructor and students. The set of lab assignments may be extend to meet IT industry need based on the standard of the students.

**Objective:**
The basic objective of the course to learn programming fundamentals and language constructor in the selected language during the course.

**Course Outcomes:**

1. The basic objective of the course to learn programming fundamentals and language constructor in the selected language during the course.

| CSC-408 Programming Language Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | 3 | 3 | | | | |

# VIII Semester

## CSC-409: Neural Networks

Neural Networks is an emerging paradigm that tries to simulate human brain. Different learning algorithms like Error correction learning, hebbian learning, Boltzmann and Competitive learning allow the networks to learn and adapt. Networks like Multilayer perceptron using back propagation and Self-organizing maps allow neural networks to solve real life problems. Concepts related to deep learning aide to the emerging trends.

**Course Objectives**

- To introduce some of the fundamental techniques and principles of neural networks.
- To investigate some common models and their applications.
- Discuss concepts related to Deep Learning.
- Laboratory exercises to cover in Lab sessions.

**UNIT 1: Introduction:** What is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

**Learning process:** Error Correction learning, Memory based learning, Hebbian learning, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process.

**UNIT 2:** Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception –convergence theorem, Relation between perception and Baye's classifier for a Gaussian Environment; Multilayer Perceptron- Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, Computer experiment, feature detection, Back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

**UNIT 3: Self-organization maps:** Two basic feature mapping models, Self-organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization, Adaptive pattern classification, Hierarchal Vector quantizer, contextual Maps Hopfield models.

**UNIT 4:** Introduction to Deep Learning.

**BOOKS:**

1. Neural networks A comprehensive foundations, Simon Haykin, Pearson Education 2nd Edition 2004.
2. Artificial neural networks - B.Vegnanarayana Prentice Halll of India P Ltd 2005
3. Neural networks in Computer intelligence, Li Min Fu TMH 2003.

**Course Outcomes:**

1. To introduce some of the fundamental techniques and principles of neural networks.
2. To investigate some common models and their applications.
3. Discuss concepts related to Deep Learning.

| CSC-409 Neural Networks | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | 3 | | 2 | | |
| CO2 | | 3 | | 3 | | 2 | | |
| CO3 | | 3 | | 3 | | 2 | | |

## CSC-410: MACHINE LEARNING

Machine Learning Course Outline: Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome and a lot of other applications. In this course, you will learn about the most effective machine learning techniques, and gain practice implementing them and getting them to work for yourself. More importantly, you'll learn about not only the theoretical underpinnings of learning, but also gain the practical know-how needed to quickly and powerfully apply these techniques to new problems. The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to building smart systems, text , computer vision, medical informatics, audio, database mining, and other areas.

**Objective of the Machine Learning Course:**

- The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets.
- Several libraries and data sets are publicly available, that will be used to illustrate the application of machine learning algorithms.
- The emphasis will be on machine learning algorithms and applications, with some broad explanation of the underlying principles.
- To develop the basic skills necessary to pursue research in machine learning.
- To develop the design and programming skills that will help you to build intelligent, adaptive artifacts.

**UNIT 1:** Basics: Introduction to Machine Learning - Different Forms of Learning, Basics of Probability Theory, Linear Algebra and Optimization. Regression Analysis: Linear Regression, Ridge Regression, Lasso, Bayesian Regression, Regression with Basis Functions.

**UNIT 2:** Classification Methods: Instance-Based Classification, Linear Discriminant Analysis, Logistic Regression, Large Margin Classification, Kernel Methods, Support Vector Machines, Multi-class Classification, Classification and Regression Trees.

Neural Networks: Non-linear Hypotheses, Neurons and the Brain, Model Representation, Multi-layer Networks, Back-propagation, Multi-class Discrimination, Training Procedures, Localized Network Structure, Deep Learning.

**UNIT 3 :** Graphical Models: Hidden Markov Models, Bayesian Networks, Markov Random Fields, Conditional Random Fields. Ensemble Methods:Boosting - Adaboost, Gradient Boosting, Bagging - Simple Methods, Random Forest. Clustering:Partitional Clustering - K-Means, K-Medoids, Hierarchical Clustering - Agglomerative, Divisive, Distance Measures, Density Based Clustering – DBscan, Spectral Clustering.

**UNIT 4 :** Dimensionality Reduction: Principal Component Analysis, Independent Component Analysis, Multidimensional Scaling, and Manifold Learning.

Reinforcement Learning: Q-Learning, Temporal Difference Learning

**BOOKS**

Recommended Textbooks:

Pattern Recognition and Machine Learning. Christopher Bishop.

Machine Learning. Tom Mitchell.

Additional Textbooks:
Pattern Classification. R.O. Duda, P.E. Hart and D.G. Stork.
Data Mining: Tools and Techniques. Jiawei Han and Michelline Kamber.
Elements of Statistical Learning. Hastie, Tibshirani and Friedman. Springer.

**Course Outcomes:**

1. The objective is to familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets.
2. Several libraries and data sets are publicly available, that will be used to illustrate the application of machine learning algorithms.
3. The emphasis will be on machine learning algorithms and applications, with some broad explanation of the underlying principles.
4. To develop the basic skills necessary to pursue research in machine learning.
5. To develop the design and programming skills that will help you to build intelligent, adaptive artifacts.

| CSC-410 Machine Learning | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | 3 | | 3 | | |
| CO2 | | 3 | | 3 | | 3 | | |
| CO3 | | 3 | | 3 | | 3 | | |
| CO4 | | 3 | | 3 | | 3 | | |
| CO5 | | 3 | | 3 | | 3 | | |

## CSC-411: COMBINATORIAL OPTIMIZATION

**Objectives:**

- General understanding of optimization under constraints
- Develop knowledge and skills in linear and integer programming (LP&IP) and their applications
- Knowledge and skills in the area of general nonlinear and convex optimization
- Knowledge and implementation of discrete optimization problems and their algorithms
- Application of optimization tools in different domains of computing and data science

**UNIT 1**
Linear Programming: Linear programming problem, Simplex method, Revised Simplex method, Duality, Dual Simplex, Interior Point Method.

**UNIT 2**
Combinatorial Optimization Problems: Transportation problem, Assignment problem, Shortest path problem, Knapsack problem, Local search, Max-Flow and Min-cost problem.

**UNIT 3**
Non-Linear Unconstrained Optimization.

**UNIT 4**
Queuing Models: Characteristics of Queuing Process, Poisson Process, Birth-Death Process, Single Server Queues, Multi-Server Queues, Queues with Truncation, Finite-source Queues, Numerical Techniques & simulation.

**SUGGESTED BOOKS:**
1. Combinatorial Optimization -Theory and Algorithms, Bemhard Korte, Jens Vygen.
2. Combinatorial Optimization, W.J. Cook, W.H. Cunningham, W.R. Pulleyblank, A. Schrijver

**Course Outcomes:**

1. General understanding of optimization under constraints
2. Develop knowledge and skills in linear and integer programming (LP&IP) and their applications
3. Knowledge and skills in the area of general nonlinear and convex optimization
4. Knowledge and implementation of discrete optimization problems and their algorithms
5. Application of optimization tools in different domains of computing and data science

| CSC-411 Combinatorial Optimization | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | | 3 | | |
| CO2 | | 3 | | | | 3 | | |
| CO3 | | 3 | | | | 3 | | |
| CO4 | | 3 | | | | 3 | | |
| CO5 | | 3 | | | | 3 | | |

**CSC-412: Research Seminar of Credit: 01**

**Outline:** The students will be select a supervisor, as per the suggestion of student will select a research field, in that field student will be instructed to read 2-3 base papers from reputed journals form IEEE and Elsevier or any other peer reviewed journals

**Course Outcomes:**

1. The students will be select a supervisor, as per the suggestion of student will select a research field, in that field student will be instructed to read 2-3 base papers from reputed journals form IEEE and Elsevier or any other peer reviewed journals

| CSC-412 Research Seminar | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | 3 | 2 |

## CSC-413 Neural Networks Lab

**Course Outcomes:**

1. Implementation of Neural Networks algorithms Java/ Python/ Matlab

| CSC-413 Neural Networks Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | |

## CSC-414 Machine Learning Lab

**Course Outcomes:**

1. Implementation of Machine Learning algorithms in Python

| CSC-414 Machine Learning Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | |

## Open Elective of Science Stream

**Course Outcomes:**

2. To make the students learn about different streams of Science

| Open Elective of Science Stream | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | 3 | 3 | | | | | | | | |

## Elective (Non-Science)

**Course Outcomes:**

1. To get acquaintance with arts subjects.

| Elective (Non-Science) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | | | | | | | 1 | | |

# IX Semester

## CSC-501: DATA MINING

**Learning Objectives & Outcomes**

The student will learn to approach data mining as a process, by demonstrating competency in the use of data mining to the decision-support level of organizations

- The students will learn to categorize and carefully differentiate between situations for applying different data-mining techniques
- Identify appropriate methods to address a given problems with data mining methods such as frequent pattern mining, association, correlation, classification, prediction, and cluster and outlier analysis
- Able to design and implement data-mining solutions for different applications
- Proficiency in evaluating and comparing different models used for Data Mining

**UNIT 1:** Introduction: Knowledge discovery from databases, scalability issues Data Preparation: Pre- Processing, sub- sampling, feature selection.

**UNIT 2:** Classification and Prediction:Bayes learning, decision trees, CART, neural learning, support vector machines, associations, dependence analysis, rule generation.

**UNIT 3:** Deviation Detection: Cluster Analysis and Deviation Detection: Portioning algorithms, Density bases algorithm, Grid based algorithm, Graph theoretic clustering.

**UNIT 4:** Temporal and spatial data mining.

**BOOKS:**


1. Data Mining Concepts & techniques: Jai wei Han and Micheline Kamber, Morgan Kaufman.
2. Data Mining Techniques : Arun K. Pujari, Universities Press, Fourth Edition, ck and ps2016.
3. Mastering Data Mining: M. Berry and G. Linoff, John Wiley & Sons., 2000


**Course Outcomes:**

1. The student will learn to approach data mining as a process, by demonstrating competency in the use of data mining to the decision-support level of organizations
2. The students will learn to categorize and carefully differentiate between situations for applying different data-mining techniques
3. Identify appropriate methods to address a given problems with data mining methods such as frequent pattern mining, association, correlation, classification, prediction, and cluster and outlier analysis
4. Able to design and implement data-mining solutions for different applications
5. Proficiency in evaluating and comparing different models used for Data Mining

| CSC-501 Data Mining | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | | 3 | | 3 | | |
| CO2 | 3 | 3 | | 3 | | 3 | | |
| CO3 | 3 | 3 | | 3 | | 3 | | |
| CO4 | 3 | 3 | | 3 | | 3 | | |
| CO5 | 3 | 3 | | 3 | | 3 | | |

## CSC-502: INFORMATION RETRIEVAL AND WEB SEARCH

**COURSE OUTLINE**

Information retrieval is the process through which a computer system can respond to a user's query for text-based information on a specific topic. IR was one of the first and remains one of the most important problems in the domain of natural language processing. Web search is the application of information retrieval techniques to the largest corpus of text anywhere. The course focuses on IR methods for the processing, indexing, querying, organisation, and classification of textual documents, including hypertext documents available on the world-wide-web.

**Prerequisites**

- Students must know Data Base Management Systems.
- They must also have the concept of different types of algorithms used for searching data.
- They must also have minimal knowledge of natural language such as thesaurus, synonyms, etc.

**Objectives:**

- To provide the foundation knowledge in information retrieval.
- To present scientific support in the field of information search and retrieval.
- Demonstrate the usage of different data/file structures in building computational search engines.
- Students will be able to learn different indexing techniques to apply database systems.

**Unit 1:** Boolean Retrieval, The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms.

**Unit 2:** Dictionaries and tolerant retrieval: Search structures for dictionaries, spelling correction. Scoring, term weighting and vector space model, the vector space model for scoring, variant tf-idf functions.

**Unit 3:** Computing scores in a complete search system: Efficient scoring and ranking, components of an information retrieval system. Evaluation in information retrieval.
Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, global methods for query reformulation.

**Unit 4:** Text classification and Naive Bayes: Naive Bayes text classification, The Bernoulli model, Feature selection, Evaluation of text classification
Vector space classification: Document representations and measures of relatedness in vector spaces, Rocchio classification, k nearest neighbor, Web search.

**BOOKS**

- Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press
- Somen Chakrabarti, Web mining, Elsevier Publication
- Grossman, Information Retrieval : Algorithm and Heuristics, Springer

**Course Outcomes:**

1. To provide the foundation knowledge in information retrieval.
2. To present scientific support in the field of information search and retrieval.
3. Demonstrate the usage of different data/file structures in building computational search engines.
4. Students will be able to learn different indexing techniques to apply database systems.

| CSC-502 Information Retrieval and Web search | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | 3 | | 3 | | |
| CO2 | | 3 | | 3 | | 3 | | |
| CO3 | | 3 | | 3 | | 3 | | |
| CO4 | | 3 | | 3 | | 3 | | |

## CSC-503: SOFT COMPUTING

**Pre-requisites:** Basic understanding of Neural Networks.

Soft computing is an emerging approach to computing which can parallel the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on some biologically inspired computing paradigms such as Genetic Algorithms, Evolutionary computing, Particle Swarm Optimization, human nervous system, etc. Applying Soft Computing can help in solving real-time problems that cannot be solved using mathematical modeling. Varied applications of Soft Computing include Computer Vision, medical diagnosis, pattern recognition, network optimization etc.

**Course Objectives**

This course will uncover the fundamental concepts used in Soft computing. The concepts of fuzzy logic, Neuro-fuzzy computing, genetic algorithms will be discussed. Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices. In summary, this course will provide exposure to theory as well as practical systems and software used in soft computing. Broad Objectives of the course are:

- To develop understanding of Fuzzy logic and its applications.
- Solve problems using Neuro-fuzzy computing and its applications.
- In-depth study and discussion on Genetic Algorithms and Evolutionary computing.

- Apply Particle Swarm optimization, ant colony optimization and other algorithms to real life problems.
- Laboratory exercises to covered in Lab sessions.

**Unit 1:** Foundations: Stochastic processes; Principal Component Analysis; Learning theory; Generalization and Regularization; Simulated Annealing.

**Unit 2:** Fuzzy Sets; Chaos theory; Evolutionary algorithms and genetic programming

**Unit 3:** Methodologies: Neural networks architectures for complex pattern recognition tasks - Fuzzy neural networks and chaos in neural networks

**Unit 4:** Particle search optimization, Artificial Bee colony search, Ant colony algorithm and similar algorithms.

**Books**

1.Neuro Fuzzy & Soft Computing - J.-S.R.Jang, C.-T.Sun, E.mizutani, Pearson Education
2.Digital Neural Network - S.Y.Kung, Prentice Hall International Inc.
3.Spiking Neural Networks - Wulfram Gerstner, Wenner Kristler, Cambridge University Press.
4.Neural Networks and Fuzzy Systems: Dynamical Systems Application to Machine Intelligence - Bart Kosko, Prentice Hall.

**Course Outcomes:**

1. To develop understanding of Fuzzy logic and its applications.
2. Solve problems using Neuro-fuzzy computing and its applications.
3. In-depth study and discussion on Genetic Algorithms and Evolutionary computing.
4. Apply Particle Swarm optimization, ant colony optimization and other algorithms to real life problems.
5. Laboratory exercises to cover in Lab sessions.

| CSC-503 Soft Computing | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | 3 | | 3 | | |
| CO2 | | 3 | | 3 | | 3 | | |
| CO3 | | 3 | | 3 | | 3 | | |
| CO4 | | 3 | | 3 | | 3 | | |
| CO5 | | 3 | | 3 | | 3 | | |

## Open Elective of Science Stream

**Course Outcomes:**

3. To make the students learn about different streams of Science

| Open Elective of Science Stream | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | | 3 | 3 | | | | | | | | |

## Elective (Non-Science)

**Course Outcomes:**

2. To get acquaintance with arts subjects.

| Elective (Non-Science) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | 3 | | | | | | | | | 1 | | |

## CSC-504 Mini Project

**Course Outcomes:**

1. Inculcating Critical and Research & Development skills

| CSC-504 Mini Project | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 2 | 3 | | 2 | 2 |

## CSC-505 Data Mining Lab

**Course Outcomes:**

1. Implementation of Data Mining techniques in any programming language/ Weka tool

| CSC-505 Data Mining Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | |

## CSC-506 Soft Computing Lab

**Course Outcomes:**

1. Implementation of Soft Computing techniques in any programming language

| CSC-506 Soft Computing Lab | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | 3 | | | | | |

# X Semester

### CSC-507:- Project Work in Industry or Institution (16 Weeks)

**Objective:-**

Before starting internship, the student will gain prerequisite knowledge of working in an industry or academic research. Major projects should encourage students to solve real-life problems.

**Course Outcomes:**

1. Before starting internship, the student will gain prerequisite knowledge of working in an industry or academic research. Major projects should encourage students to solve real-life problems.

| CSC-507 Project Work in Industry or Institution | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 |
|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | 3 | 2 | 2 | 1 |

# Electives

### CSC-331: COMPUTER GRAPHICS

**Objective:**

After completion of this course students will be able to draw 2 dimensional graphical objects using geometrical algorithms and performs operations on them.

**UNIT I:** Introduction: Cathode Ray tube, Video Display Devices, Raster Scan Systems, Random Scan systems. Input devices.

**UNIT II:** Line drawing algorithms- DDA Algorithm. Bresenham's Line Algorithm. Circle and Eclipse generating algorithms. Midpoint Circle Algorithm.
Scan-line polygon fill algorithm. Inside-Outside tests. Scan- Line fill of curved Boundary Areas. Boundary fill Algorithm. Flood fill Algorithm.

**UNIT III:** Geometric Transformations: Matrices. Translation, Scaling Transformations. Rotation, Homogeneous Co-ordinates and Translation, Reflexion, Shear.

Clipping: Clipping operations, point clipping. Line clipping. Cohen- Sutherland. Line Clipping. Polygon clipping. Sutherland Hodge man clipping

3D Viewing: Plane. Different types of projections.

**UNIT IV:** Fractals Graphics- Introduction to fractals, some natural examples, one-step feedback machine, Multiple Reduction Copy Machine, properties of fractal objects. fractal dimension, Applications of fractals. Generation of a few fractals, e.g., Cantor set, Fractal carpet, Koch curve etc.

**Text Book/References:**

1. Computer graphics: Principles and Practice - James D Foley.
2. Fundamentals of Computer Graphics - Peter Shirley, Michael Ashikhmin.
3. Geometric Tools for Computer Graphics - Philip J Schneider, David H Eberly.
4. Data Mining By Gopalan & Sivaselvan, PHI Learning Pvt. Ltd.
5. Data mining: Theory, Methodology, Techniques and Applications by Graham J. Williams, Simeon J. Simoff. Springer Science & Business, 2006
6. Data Mining Techniques by Arun k Pujari, University Press, 2007

**Learning Outcomes:**

- To understand basic display Devices, Input Devices.
- To learn Line Drawing Algorithms, Circle and Ellipse Drawing Algorithms, 2D Transformations, Line and Polygon clipping, Color Fill Methods, 2D Projections.
- To learn introduction of Fractal Graphics.

## CSC-332: Internet Technologies

Internet Technologies aide in developing applications in the today's WWW world.

**Course Objectives**

- To introduce the basics of Website designing languages like HTML and JavaScript.
- To develop applications using Java.
- Do Advanced Java programming using servlets, RMI, JDBC and swings.
- Laboratory exercises to cover in Lab sessions.

**UNIT I:** An overview of Java: Object oriented programming, Two paradigms, abstraction, the, OOP principles, Java class libraries, Date types, variables and arrays, Operators
Class fundamentals, declaring object reference variable, Introducing methods, constructors, the key word, garbage collection, the finalize () method. Overloading methods, using objects as parameters, classes, using exceptions. Inheritance and polymorphism, String handling, Exception handling

**UNIT II:** The internet: history of the World Wide Web, object technology –java script object, scripting for the web-browser portability.
Introduction of HTML HTML: common tags and controls, HTML basic HTML forms, more complex HTML forms, internal linking, creating and using image maps.

**UNIT III:** Applets & Java script – Introduction to Applets: Applet Fundamentals, using paint method introduction to scripting: introduction- memory concepts- arithmetic- decision making. Java script control structures, Java script functions: introduction – program modules in avascript - function definitions, duration of identifiers, scope rules, recursion, java script global functions.
Java script arrays: introduction, array-declaring and allocating arrays, references and reference parameters – passing arrays to functions, multiple subscripted arrays. Java script objects: introduction, math, string, data, Boolean and number objects.

**UNIT IV:** Servlets: Lifecycle of a servlet, types of servlets: Generic servlets, HTTP, GET and POST method, RMI, java beans, JDBC, ODBC, Swings

**Text/References**

1. Herbert Schildt: JAVA 2 - The Complete Reference, TMH, Delhi
2. Deitel: How to Program JAVA, PHI

3. U.K. Chakraborty and D.G. Dastidar: Software and Systems – An Introduction, Wheeler Publishing, Delhi.
4. Joseph O'Neil and Herb Schildt: Teach Yourself JAVA, TMH, Delhi.

**Outcomes:-**

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

- Develop websites using HTML and Javascript
- Understanding of concepts of Java programming using inheritance, polymorphism.
- Able to develop Java applets.
- Understanding of the life cycle of servlets and do advanced java programming.

## CSC-333: Ecommerce

**Course Objective:** This course focuses on Presents concepts and skills for the strategic use of e-commerce and related information technology from three perspectives: business to consumers, business-to-business, and intra-organizational. Examination of e-commerce in altering the structure of entire industries, and how it affects business processes including electronic transactions, supply chains, decision making and organizational performance.
In addition, some of the major issues associated with e-commerce—security, privacy, intellectual property rights, authentication, encryption, acceptable use policies, and legal liabilities. Students will build their own web presence and market it using an online platform.

**UNIT-I**: **Introduction to E-commerce**

Meaning and Concept; Objectives; Advantages and Disadvantages; Technical components and functions of e-commerce; E-Commerce and E-Business; Traditional Commerce vs. E-Commerce; Forces Driving E-Commerce; Growth of E-Commerce; E-Commerce Opportunities for Industries; Future of E-Commerce.

**UNIT-II**: **E-Commerce Model and Websites**

Forms of E-Commerce- Business to Consumer; Business to Business; Business to Government; Other Models – Brokerage Model, Aggregator Model, Community Model and Value Chain Model; Transaction Process: Basic concepts of EDI; Applications of EDI.

**UNIT-III** : **Electronic Payment System and E-Security & Privacy**

Special Features of Electronic Payment System; Types of E-Payment Systems-E-Cash, E-Cheque, Credit Card, Smart Card and Electronic Purses, Risk and E-Payment Systems; Secure Electronic Transaction (SET)
Security Risk of E-commerce; Types of Intruders; Types of Threats; Security Tools-Cryptography; Software packages for privacy; Security algorithms; Digital Signature and Firewalls.

**Unit-IV Web Designing**

Preparing Web pages and Website, Use of HTML and DHTML and scripting languages; Websites Generation- Concept and Meaning; Objectives and Advantages; Types of Websites; Website Designing Principles; Methods of Promoting Website; Searching the Website; Factors for Growth of Websites

**References:**

1. William Stallings, Cryptography and Network security Principles and practice.
2. Kalakota, Ravi and Whinston, Andrew B., Electronic Commerce – A Manager's Guide, Pearson Education, Inc
3. Diwan, Prag and Sunil Sharma: Electronic Commerce – A manager's Guide to E-Business, Vanity Books International, Delhi.
4. Janal, D.S.: On-line Marketing Hand Book, Van Nostrand Reinhold, New York.

5. Kosivr, David: Understanding Electronic Commerce, Microsoft Press, Washington.
6. Robert W. Sebesta, Programming the World Wide Web, Sixth Edition, Published by Addison-Wesley. Copyright © 2011 by Pearson Education, Inc.
7. Mlnoli and Minol: Web Commerce Technology Handbook, Tata McGraw Hill, New Delhi.
8. Schneider Gary P: Electronic Commerce, Course Technology, Delhi.

**Learning Outcome:** At the end of this course, students should be able to

1. Identify and apply relevant problem solving methodologies.
2. Identify advantages and disadvantages of technology choices such as merchant server software and electronic payment options
3. Discuss electronic commerce and the stakeholders and their capabilities and limitations in the strategic convergence of technology and business.
4. Analyse features of existing e-commerce businesses, and propose future directions or innovations for specific businesses.

## CSC-334 OPEN SOURCE OPERATING SYSTEM

The course is designed to develop an understanding of Free and Open Source Software. It will discuss how shell variables and shell scripting can be used.

**Course Objectives**

- To introduce the concept of Free and Open Source Software.
- To understand the role of Kernel and shell.
- To demonstrate different commands in Linux.

**UNIT I:**
**Introduction**: open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean any cost. History : BSD, The Free Software Foundation and the GNU Project. Open Source Development Model Licences and Patents: What Is A License, Important FOSS Licenses (Apache, BSD, GPL, LGPL).

**UNIT II:**
**Open source operating system:** Overview of Open Source operating systems, Introduction to Linux and Unix, Flavours of *NIX Operating systems.

**UNIT III:**
**Introduction to Linux:** File system, Shell and Kernel,vi editor, shell variables, command line programming.

**UNIT IV:**
**Filters and commands:** Pr, head,tail, cut,paste,sort,uniq,tr,join, etc,grep,egrep, fgrepetc., sed,awk etc.,granting and revoking rights.Any other relevant topic.

**BOOKS:**
1. Brian W. Kernighan, The Practice of Programming, Pearson Education.
2. Bach Maurice J, Design of the Unix Operating system, PHI.
3. Daniel P. Bovet, Understanding the Linux Kernel, Oreilly.

**Outcomes:-**
At the end of this course, the student will be able to

- Demonstrate the understanding of different *NIX operating systems.
- Work on Linux using different commands and develop shell scripts.

## CSC-335: Discrete Structures

**Course Outline:**
Discrete mathematics is the backbone of computer sciences. It provides the base for algorithm development and semantics of programming languages. This course is designed to given an introductory idea of different discrete structures, including graph theory. In particular, this course introduces logic, proofs, sets, relations, functions, counting, and abstract structure, with an emphasis on applications in computer science.

**UNIT I:** Sets: Definition and types, Set operations, Partition of set, Cardinality (Inclusion-Exclusion & Addition Principles), Recursive definition of set. Functions, Relations, Properties of binary relations, closure, Partial Ordering Relations, The Pigeonhole & Generalized Pigeonhole Principles, Composition of Functions Concept, Mathematical induction

**UNIT II**: Graph Theory: Graphs – Directed, Undirected, Simple,. Adjacency & Incidence, Degre of Vertex, Subgraph, Complete graph, Cycle & Wheel Graph, Bipartite & Complete Bipartite Graph, Weighed Graph, Union of Simple Graphs. Complete Graphs. Isomorphic Graphs, Path, Cycles & Circuits Euclerian & Hamiltonian Graphs.

**UNIT III:** Planar Graph: Kuratowski's Two Graphs, Euler's Formula, Kuratowski's Theorem.
Trees: Spanning trees- Kruskal's Algo, Finding Spanning Tree using Depth First Search, Breadth First Search, Complexity of Graph, Minimal Spanning Tree, Graph Coloring.

**UNIT IV:** Language of Logic: Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contrpositive, Bi-conditional Statements, tautology, Contradiction & Contingency, Logical Equivalences, Quantifiers, Arguments Groups, Ring, fields and Lattice

**Text/Reference Books**

1. C.L Liu and D.P. Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, TMH, 3rd Edition
2. Rosen, Discrete Mathematics and its applications, 6th Edition
3. Schaum's Outlines of Discrete Mathematics, Seymour Lipschutz & Marc Lipson, 2nd Edition
4. Narsingh & Deo, Graph Theory with Applications to Engineering and Computer Science, PHI 2004 Publication

**Learning Outcomes**
This introductory course will allow students to learn the following:

- Fundamental mathematical concepts and terminology underlying a variety of discrete structures.
- Use of graph and its analysis for a variety of practical problems like shortest distance, and Binary search tree.
- Techniques of constructing mathematical proofs and use of propositional and predicate logic.

# CSC-336: Information Security

**Course Outline: -** The designed course covers basic security aspects to protect network from various kind of attacks. Various kinds of encryption and decryption techniques to protect data from malicious users. Course covers DES and RSA logarithms which are basic symmetric and asymmetric algorithms. Course also covers various authentication mechanisms.

**Objectives:**

1. To understand security fundamentals.
2. To learn Cryptography Principles such as key exchange, digital signature and certificates.
3. Demonstration of various encryption decryption schemes by taking plain text.
4. Generation Message Authentication codes for different kinds of messages.

**UNIT I:** Introduction to security, attacks, computer criminals, security services.
Cryptography: Substitution ciphers, transposition cipher, confusion, diffusion, symmetric and asymmetric encryption. DES, odes of DES. Hash function, key exchange, digital signatures and certificates.

**UNIT II:** Public Key Cryptosystems: Principles of Public Key Cryptosystems, Factorization, RSA Algorithm, security analysis of RSA, Exponentiation in Modular Arithmetic. Key Management in Public Key Cryptosystems: Distribution of Public Keys, Distribution of Secret keys using Public Key Cryptosystems. Discrete Logarithms, Diffie-Hellman Key Exchange.

**UNIT III:** Message Authentication & Hashing: Birthday Paradox and General case of Duplications, Basic functions of Message Authentication and Hashing, Introduction to Hash & MAC algorithms.
Digital Signatures: RSA Based, El Gamal Signatures, Undeniable Signatures.
Authentication: Model of Authentication Systems, Impersonation, Substitution and spoofing games, Authentication schemes for mutual authentication based on shared secret, two-way public key, one-way public key, Mediated Authentication, One way Authentication

**UNIT IV:** Security in networks: Threats in networks, network security controls, firewalls, intrusion detection system Administrating security: Security planning, risk analysis, physical security, Ethical issues in security

**Text/Reference Books**

1. Stalling Williams: Cryptography and Network Security: Principles and Practices, 4th Edition, Pearson Education, 2006.
2. Kaufman Charlie et.al; Network Security: Private Communication in a Public World, 2nd Ed., PHI/Pearson.
3. Pieprzyk Josef and et.al; Fundamentals of Computer Security, Springer-Verlag, 2008.
4. Trappe & Washington, Introduction to Cryptography, 2nd Ed. Pearson.

**Outcomes:-**

1. Students will able to understand the security features to improve the reliability in communication system.
2. Able to find the encrypt message by using various encryption mechanisms.
3. Various message authentication codes and message digest algorithms to improve the security aspects in data transmission.

## CSC-431: WEB TECHNOLOGY

**Course Description**: This course is an overview of the modern Web technologies used for the Web development. The purpose of this course is to give students the basic understanding of how things work in the Web world from the technology point of view as well as to give the basic overview of the different technologies.

**Course Contents:** The topics include (although in some cases briefly): History of the Web, Hypertext Markup Language (HTML), Extensible HTML (XHTML), Cascading Style Sheets (CSS), JavaScript, and Extensible Markup Language (XML).

We will follow the guidance of the World Wide Web Consortium (W3C) to create interoperable and functional websites.

**Overall Course Objectives**:

Upon completion of this course the student will be able to
1. Describe and explain the relationship among HTML, XHTML, CSS, JavaScript, XML and other web technologies;
2. Get familiar with W3C standards and recommendations;
3. To create and publish a basic web page using HTML and its many tags;
4. To describe limitations of creating interactivity including browser support and differences;
5. To describe the difference between Java and JavaScript;
6. To understand and use JavaScript variables, control structures, functions, arrays, and objects;
7. To learn and modify CSS properties using JavaScript;
8. To find out what are XML syntax, elements, attributes, validation etc.;
9. To utilize HTML, XHTML, CSS, XML, and JavaScript to develop an interactive web site.

## CSC-432: CLOUD COMPUTING

**Pre-requests to the course: -**

- Computer Networks.
- Operating System.

**COURSE OUTLINE: -** Cloud computing is service-oriented paradigm for internet users to avail the services. It is a model enables for ubiquitous and on-demand accesses to share a pool of resources, which are minimal efforts required for users as well as service providers. This course will give details about various cloud-computing services such as software as a service, platform as a service and Infrastructure as service to the service providers to run applications without any interruption and to save the IT Infrastructure cost while hosting applications over the Internet.

**Objectives:-**

- Demonstrate the various Distributed technologies to perform the complex task in highly distributed environment.
- Demonstrate the service oriented architecture to provide on-demand services to Internet users.
- Design service level agreements (SLA) to meet the guaranty services in Cloud Environment.
- Design Energy efficient Scheduling techniques to balance the Workload in a distributed environment.

- Design Energy Efficient model for sustainable cloud platform for next decade various novel service integration paradigm.

**Unit 1:** Introduction Introduction to Cloud Computing, Roots of Cloud Computing: Fundamental concepts of Distributed Systems, Cluster Computing, Grid Computing, and Mobile Computing.

**Unit 2:** Cloud Models Basics of Cloud Computing Concepts, Characteristics of Cloud Computing, Need for Cloud, Cloud Deployment models: private, public, hybrid and community cloud, Cloud Services: Resource-as-a-Service (RaaS), Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS), Examples of each service.

**Unit 3:** Cloud Services RaaS: Usage of Physical resources like servers, networks, data center etc, IaaS: Virtualization,. PaaS: Integrated lifecycle platform: Google App Engine, Microsoft Azure, Anchored life cycle platform: Salesforce platform, SaaS: Characterizing SaaS, Salesforce's software environment.

**Unit 4:** Resource Scheduling for Cloud Computing: - Introduction, Virtual Machine provisioning and Migration Services, Scheduling techniques of Virtual machines for resource reservation, Cloud Service Scheduling hierarchy, Economic models for Resource-allocation scheduling , Heuristic Models for task –execution scheduling : Static Strategies , Dynamic Strategies , Heuristic Schedulers. Cloud Applications Cloud Applications, Cloud challenges, Cloud Security and privacy issues, Mobile Cloud Computing, Integration of Cloud with Wireless Sensor Network and its application.

**Text Books:**

1. Cloud Computing Bible by Barrie Sosinsky, Wiley Publication, 2011.
2. Cloud Computing: A Practical Approach by Anthony T. Velte Toby J. Velte, Robert Elsenpeter, The McGraw-Hill Publication, 2010.
3. Cloud Computing: Concepts, Technology and Architecture by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, 1st Edition, Prentice Hall.
4. Cloud Computing: Data-Intensive Computing and Scheduling by Frederic Magoules , Jie Pan, and Fei Teng. CRC Press. Taylors & Francis Group.

**Reference Books:**

1. Cloud Computing for Dummies, Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Wiley Publication.
2. New frontiers in information and software as a service, Divyakant Agrawal, K. SelcukCandan, WenSyan Li (Eds.), Springer Proceedings.
3. Cloud Computing Theory and Practice Danc. Marinercus, Elsevier, 2013.

**Outcomes:-**

- Student will able to understand basic concepts required to develop cloud computing applications.
- Student will able to develop applications for cloud computing to provide on-demand services required for users.
- Student will able to understand the service oriented architecture such as IaaS, PaaS and SaaS.
- Student will able to design and implement a novel cloud computing application in simulation environment.
- Student will able to do comparative study and analysis of different economic cloud computing models with existing conventional software developing methodologies.

## CSC-433 GRID COMPUTING

**Prerequisites:**

- Computer Networks
- Distributed Computing

**Outline of the Course: -**

The proposed course work illustrates the infrastructure framework for distributed and Cluster computing. Course work describes the protocol frame work for open source grid frame work to proper utilization of infrastructure based on the load availability. Resource utilization and task execution time should be minimizing while executing the workflows in highly distributed heterogeneous environment.

**Objectives:**

1) Demonstrate the Infrastructure required performing group of similar task together to solve a particular problem.
2) Grid Architecture and standards to establish IT Infrastructure to solve particular tasks.
3) To understand various Grid Service models to provide effective IT Infrastructure for IT needs.
4) To learn virtualization of Hardware, Software and Networking for effective services and resource utilization based on the need and demand.
5) To learn programming methodology and Simulators to demonstrate and validate the proposed protocols in grid service architecture.

**UNIT I: INTRODUCTION**

Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network based systems – clusters of cooperative computers – Grid computing Infrastructures – cloud computing – service oriented architecture – Introduction to Grid architecture and standards – Elements of Grid – Overview of Grid architecture.

**UNIT II: GRID SERVICES**

Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements – Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services.

**UNIT III: VIRTUALIZATION**

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software – Pros and Cons of cloud computing – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – Virtual clusters and Resource Management – Virtual for data center automation.

**UNIT IV: PROGRAMMING MODEL**

Open source grid middleware packages – Globus Toolkit (GT4) Architecture, Configuration – Usage of Globus – Main components and Programming model – Introduction to Hadoop Framework – Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.

**TEXTBOOK**

1. Ahmar Abbas, “Grid Computing: A Practical Guide to Technology and Application”, Charles River Media, 2005.
2. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, “Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet”, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.

**REFERENCES**

1. Bart Jacob, “Introduction to Grid Computing”, IBM Red Books, Vervante, 2005.
2. Tom White, “Hadoop the Definitive Guide”, First Edition. O”Reilly, 2009.
3. Joshy Joseph and Craig Fellenstein, “G rid Com puting”, Pearson Education, 2003.
4. Ian Foster and Carl Kesselm an, “The Grid2: Blueprint for a New Computing Infrastructure”, Morgan Kaufman, 2004.

**Outcomes:**

- Understand the concept of various distributed platforms such as cluster computing, Distributed Computing and Cloud Computing.
- Know the basic concepts of Grid Infrastructure and practical and overall view of OGSA/OGSI.
- Understanding of Research Challenges and issues in Data Grid and Computational Grid.
- Understanding of Virtualization and its practical impact on Grid Infrastructure to enhance the performance of infrastructure.
- Hands on practice on Gridsim and CloudSim Simulator to know the performance of proposed protocols in Grid Environment.

## CSC-434 Adhoc Networks

**Outline of the Course: -**

The proposed course covers a special class of Wireless Networks which are Ad-Hoc Networks in which structure of networks varying with respect to time. In real life these networks play vital role in advanced communication system. The best practical examples of Ad-Hoc Networks is VANETs, it is practical implementation of Ad-Hoc networks to serve various on-demand application of internet users. Now-a-Days most of the applications require ad-hoc networks because of on-demand day-to-day needs. The proposed course covers research issues in various layers. One of the major concerns is energy management in Wireless Ad-Hoc Networks to design adaptive protocols.

**Objectives: -**

- Demonstration of available spectrum for Wireless Communication for various operations.
- Allocation details of spectrum to various applications.
- The need of Ad-Hoc Networks for various applications.
- Channel allocation mechanism for various on-demand applications using Ad-Hoc Networks.
- Various Network Layer protocol operations for routing the packets.
- Energy Management scheme while transmitting the data.

**UNIT I: INTRODUCTION**

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless Channel, Mobile ad hoc networks (MANETs) and Vehicular ad hoc networks (VANETs): concepts and architectures. Applications and Design Challenges of MANETs and VANETs.

**UNIT II: MAC PROTOCOLS**

Issues in designing a MAC Protocol, Classification of MAC Protocols: Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11. IEEE Standards: 802.11a, 802.11b etc,. 802.15, HIPERLAN

**UNIT III: ROUTING PROTOCOLS**

Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Power Aware Routing Protocols. Multi cast routing in Ad Hoc Wireless Networks: Issues in Designing a Multicast Routing Protocol, Classifications of Multicast Routing Protocols. Energy Efficient Multicasting, Multicasting with Quality of Service Guarantees, Application Dependent Multicast Routing.

**UNIT IV: ENERGY MANAGEMENT**

Energy Management in AdHoc Wireless Networks: Classification of Energy Management Schemes, Transmission Power Management Schemes, System Power Management Schemes. Special topics in Ad Hoc and wireless networks.

**TEXTBOOKS**


1. C S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India, 2nd ed. 2005.
2. R. Hekmat, Ad hoc Networks: Fundamental Properties and Network Topologies, Springer, 1st ed. 2006.


**REFERENCES**


1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy Efficient Real Time Data Communications, Springer, 1st ed. 2006.
2. Carlos De MoraisCordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2006.
3. G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S.Biagioni, Multi Hop Ad Hoc Networks from Theory to Reality, Nova Science Publishers, 2008.


**Outcomes:-**

1. The proposed course improves the connectivity to share information for various applications.
2. Basic understanding of signals and physical layer medium for transmitting the data in the form of analog signal.
3. Understating of channel allocation strategy to improve the connectivity in Ad-Hoc Networks.
4. Able to design and develop new routing protocol for MANETs.
5. Detail study of various kind routing protocol such as proactive, reactive and hybrid kind to improve the performance of Ad-Hoc Networks.
6. Able to introduce various energy efficient routing protocol schemes for ad-hoc networks.

## CSC-435 DIGITAL IMAGE PROCESSING

**COURSE OUTLINE:** The course focuses on basic and essential topics in Digital Image Processing, including Pixels, Pre-Processing of images, Image Restoration, Segmentation, Morphological Properties and Pattern Recognition.

**Objectives:-**

- Learn about the basics of images
- Design various kinds of mathematical models to perform Imaging operations.
- Demonstrate the various kinds of operations on different images for various applications.
- Work on real time applications like segmentation, restoration, object detections, bio-metric application.
- To identify the limitation of the proposed model and try to find the models overcome the limitations.

**The Digitized Image and its Properties:** Applications of image processing, image function, image representation, sampling, quantization, color images, metrics and topological properties of digital images, histograms, image quality, noise image.

**Image Pre-processing:** Pixel brightness transformation, geometric transformation, local pre-processing- image smoothening, scale in image processing, spatial operation, intensity transformation and spatial filtering, color models, gray scale transformation.

**Image Restoration:** Image degradation and re-storage process.

**Segmentation:** Point, line and edge detection, Threshold detection methods, parametric edge models, edges in multi spectral images, thresholding, Region based segmentation.

**Morphological properties of image:** Erosion and Dilation, opening and closing, basic morphological algorithms.

**Image representation and description:** Representation, border following and chain codes, boundary descriptors, regional descriptors.

**Pattern Recognition Fundamentals:** Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.

**Text/References:**

1. Digital Image Processing: Rafel C. Gonzalez Richard E. Woods, Second edition, Addison-Wisley.
2. Digital Image Processing: A K Jain, PHI
3. R. M. Haralick, L. G. Shapiro. Computer and Robot Vision. Addison-Wesley, 1993.
4. A. Rosenfeld, A. C. Kak. Digital Picture Processing. Addison-Wesley, 1983
5. D. A. Forsyth, J. Ponce. Computer Vision: A Modern Approach. Prentice-Hall, 2003.
6.C. R. Giardina, E. R. Dougherty. Morphological Methods in Image and Signal Processing. Prentice-Hall, Englewood Cliffs, New Jersey, 1988. 37
7. Pattern Recognition and Image Analysis: Earl Gose, Richard Johnsonbaugh, Prentice Hall of India Private Limited, 1999.
8. Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addison –Wesley publishing company.

**Course Outcomes:**

Graduates after completing the course shall gain:

- Ability to enhance student skill in digital image processing, emphasizing problem solving techniques such as doing experiments, collecting data, find out features, recognizing patterns, segmentations, and numeric computations exercises.
- Ability to understand the thought-provoking applications spread throughout, establishing a strong and meaningful bridge with Images, Signals and computer science.
- To be able to have understanding of the topics and enable students to develop their problem-solving skills, hands-on experience with concepts and enhance the opportunity for computational exploration and experimentation.

## CSC-436 PARALLEL PROCESSING

**Objective:** After completion of this course students will be able to understand architectural design that provides the parallel computational power to the computer.

**Unit-I:** Pipeline and Vector Processing: Nonlinear and linear pipelining, Multiprocessor, Multicomputer, Super computer. Array Processors. Scope and Application of Parallel approach.

**Unit-II:** Paradigms of parallel computing: SIMD, Systolic; Asynchronous - MIMD, reduction paradigm. Hardware taxonomy: Flynn's classifications, Handler's classifications. PRAM model and its variants: EREW, ERCW, CRCW, PRAM algorithms, Sorting network, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism.

**Unit-III**: Parallel Processors: Taxonomy and topology - shared memory mutliprocessors, distributed memory networks. Processor organization - Static and dynamic interconnections. Embeddings and simulations.

**Unit-IV:** Performance Metrices: Laws governing performance measurements. Metrices - speedup, efficiency, utilization, cost, communication overheads, single/multiple program performances, bench marks.
Scheduling and Parallelization: Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs. Parallel programming support environments.

**BOOKS:**
1. M. J. Quinn.Parallel Computing: Theory and Practice, McGraw Hill, New York, 1994.
2. T. G. Lewis and H. El-Rewini. Introduction to Parallel Computing, Prentice Hall, New Jersey, 1992.
3. T. G. Lewis.Parallel Programming: A Machine-Independent Approach, IEEE Computer Society Press, Los Alamitos.
4. Sima and Fountain, Advanced Computer Architectures, Pearson Education.
5. Mehdi R. Zargham, Computer Architectures single and parallel systems, PHI.
6. Ghosh, Moona and Gupta, Foundations of parallel processing, Narosa publishing.
7. Ed. Afonso Ferreira and Jose' D. P. Rolin, Parallel Algorithms for irregular problems - State of the art, Kluwer Academic Publishers.
8. Selim G. Akl, The Design and Analysis of Parallel Algorithms, PH International.

**Learning Outcomes:**
At the end of this course, the student will be able to:

- Understand uniprocessor computer architecture
- Understand the computer architecture (i.e., pipelining and superscalar processor design and memory hierarchy)
- Understand parallel hardware and parallel software
- Understand shares-memory management
- Understand distributed-memory with MPI
- Understand general-purpose GPU

## CSC-437 NATURAL LANGUAGE PROCESSING

**Objectives:**

- To understand Levels of Language Analysis, Organization of Natural language Systems
- To learn Linguistic Background: An outline of English syntax.
- To learn Grammars and Parsing, Morphological Analysis, Parsing with Features, Various Lexicon Resource & Knowledge Source
- To understand Grammars for Natural Language, Ambiguity Resolution

**UNIT I :** Introduction to Natural Language Understanding: The study of Language, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

**UNIT II :** Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. 33. Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Various Lexicon Resource & Knowledge Source, Study of Word Net and Indo Net

**UNIT III:** Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars, Hold mechanisms in ATNs. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser, Study of POS Tagger, Stemmer

**UNIT IV**

Ambiguity Resolution: Statistical Methods, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form: Word senses and Ambiguity, Encoding Ambiguity in Logical Form. Discourse Analysis and Pragmatic Analysis

**Books Recommended**:

1. JAMES ALLEN, Natural Language Understanding, 2/e, Pearson Education, 2003.
2. D. JURAFSKY, J. H. MARTIN, Speech and Language Processing, Pearson Education, 2002.
3. CHRISTOPHER D. MANNING, HINRICH SCHÜTZE, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts.1999.
4. U. S. TIWARY, TANVEER SIDDIQUI, Natural Language Processing and Information Retrieval, Oxford University Press (2008).
5. AKSHAR BHARATI, VINEET CHAITANYA, RAJEEV SANGAL, Natural Language Processing: A Paninian Perspective

**Outcome:** After completion of this course students will be able to design a model of a prototype language.

## CSC-438 HIGH PERFORMANCE COMPUTING

**Prerequisites:**

- Computer Networks.
- Operating Systems.

**Outline of the Course:**

The proposed course describes computer architecture which can support for parallel processing to improve the processing speed. The designed course will give an overall description to design parallel algorithms to solve mathematical problems like matrix factorization, linear programming and solving system of equations. The designed course illustrates the design of parallel algorithms for mathematical problems.

**Objectives:-**

- Demonstrate the scientific application execution methodology in Highly Distributed Computing Environment.
- To study Processor Architecture and Memory Hierarchies which support for HPC.
- To learn Programming strategies for parallel computing to solve highly complex scientific problems.
- To understand the parallel computer concepts different types of parallel architecture, hard ware design and compilers principles.
- Illustration of well-known mathematical examples to understand the basic concepts of parallel computation which are highly required to solve scientific applications.
- Detail study of various kinds of mathematical examples where parallel computations are involved, for example in linear algebra solving system of equations and matrix decomposition, Fourier transforms.

**UNIT-I:** Single-processor Computing, The Von Neumann architecture, Modern processors, Memory Hierarchies, Multi core architectures, Locality and data reuse, Programming strategies for high performance, Power consumption, Review questions.

**UNIT-II:** Parallel Computing, Introduction ,Quantifying parallelism, Parallel Computers Architectures , Different types of memory access ,Granularity of parallelism ,Parallel programming, Topologies, Multi-threaded architectures ,Co-processors, Remaining topics, Computer Arithmetic, Integers, Real numbers, Round-off error analysis, Compilers and round-off, More about floating point arithmetic, Conclusions. Numerical treatment of differential equations, Initial value problems, Boundary value problems, Initial boundary value problem, Numerical linear algebra, Elimination of unknowns, Linear algebra in computer arithmetic, LU factorization, Sparse matrices, Iterative methods, Further Reading .

**UNIT-III:** High performance linear algebra, Collective operations, Parallel dense matrix-vector product, LU factorization in parallel, Matrix-matrix product, Sparse matrix-vector product, Parallelism in solving linear systems from Partial Differential Equations (PDEs),Computational aspects of iterative methods , Parallel preconditions ,Ordering strategies and parallelism, Operator splitting, Parallelism and implicit operations ,Grid updates ,Block algorithms on multi core architectures.

**UNIT-IV:** Applications, Molecular dynamics, Force Computation, Parallel Decompositions, Parallel Fast Fourier Transform, Integration for Molecular Dynamics, Sorting, Brief introduction to sorting Odd-even transposition sort, Quicksort, Bitonic sort, Graph analytics, Traditional graph algorithms, Real world' graphs, Hypertext algorithms, Large-scale computational graph theory, N-body problems, The Barnes-Hut algorithm, The Fast Multipole Method, Full computation, Implementation Monte Carlo Methods, Parallel Random Number Generation, Examples, Computational biology Dynamic programming approaches, Suffix tree.

**Text Book:**

1) Introduction to High Performance Scientific Computing Evolving Copy - open for comments Victor Eijkhout, Edmond Chow, Robert van de Geijn.
2) High Performance Computing (RISC Architectures, Optimization & Benchmarks), Charles Severance, Kevin Dowd, Oreilly.

**Reference Books:**

1) High Performance Computing (RISC Architectures, Optimization & Benchmarks), Georg Hager, Gerhard Wellein, CRC Press.
2) Introduction to High-Performance Scientific Computing (Scientific and Engineering Computation), Lloyd D. Fosdick, Elizabeth R. Jessup

**Outcomes:-**

- Able to understand the difference between sequential architecture and parallel architecture to execute the scientific applications.
- Understand the way to develop parallel algorithm and way of execution on parallel computing environment.
- Analysis of time and space complexity for a particular mathematical problem in sequential as well as parallel.
- Writing programs for to solve Partial differential equations (PDE) and Matrix decomposition.
- Solve some Computational biology applications using Dynamic programming approaches.

## CSC-439 GAME THEORY

**Course Outline:**

This course provides an introduction to Game Theory. Game Theory is a mathematical framework that studies strategic interactions amongst self-interested decision makers. It has applications in a wide variety of areas, including statistical decision theory, artificial intelligence (online learning, multi-agent systems), economics and business (auctions, pricing, bargaining), political science (stability of government, military strategy), philosophy (ethics, morality and social norms) and biology (evolution, signaling behavior, fighting behavior).

**Course Overview:**

The novel concepts of game theory and how to find different equilibrium solutions to different types of games will be extensively covered in this course. These will be explained and elucidated with relevant examples.

This course provides a rigorous treatment of solution concepts for games with perfect and imperfect information including rationalxizability, Nash and subgame perfect Nash equilibria. It covers topics such as auction, VNM utility function, bargaining game etc. It also discusses cooperative game solution concepts-core, Shapley value and bayesian game with Cournot's duopoly.

**UNIT 1-** Games with Perfect Information-Strategic Games; Nash Equilibrium and Existence Properties; Some Games in Normal Form, Nash Equilibria in Zero-Sum Games, Bräss' Paradox, and more on Mixed Strategies, Games in Extensive Form, Market Equilibrium and Pricing.

**UNIT 2-** Electoral Competition: Median Voter Theorem; Auctions: Definitions and The role of Knowledge; Decision Making and Utility Theory; Mixed Strategy Equilibrium;

The Paretian System Equilibrium, and Walrasian General Equilibrium Theory, Von Neumann and Morgenstern Utility Function, Theory of Risk Aversion, Equilibrium Theory.

**UNIT 3-** Sealed Bid Auctions, VCG Procedures, Generalized Vickrey Auctions, VCG Procedures, Cournot Competition and Stackelberg Equilibrium; Arrow's Impossibility Theorem, Gibbard-Satterthwaite Theorem, Bargaining Game with Alternating Offers; Bargaining Game with Alternating Offers (General Utilities); Nash Bargaining Solution; Stable Marriages; Multi-Item Auctions; Cooperative Game Theory: Cores; Stable Sets and Shapley Value.

**UNIT 4-** Strategic Games with Imperfect Information-Bayesian Games; Cournot's Duopoly with Imperfect Information; Radio Spectrum, With Arbitrary Distribution of Valuations

**BOOKS:**

1. "Fun and Games: A Text on Game Theory", Ken Binmore, A.I.T.B.S Publishers.
2. "A Course in Game Theory", Martin J. Osborne and Ariel Rubinstein, MIT Press.
3. Prajit Dutta, Strategies and Games, MIT Press

**Learning Outcomes:**

On successful completion of this course, students will be able to model competitive real world phenomena using concepts from game theory and identify optimal strategy and equilibrium solution for such models. They will be ready to explain the potential or proven relevance of game theory and its impact in various fields of human interaction which involve conflict of interest between two or more participants.

## CSC-531 Programming in Java

**Course Objectives**

- To introduce concepts of core java systematically.
- To demonstrate the principles underlying the design of high-level programming languages.

**Learning Outcome**

- The students will have competence in the use of the Java Programming language.
- The development of small to medium-sized application programs that demonstrate professionally acceptable coding.

**Unit 1**- Fundamentals of object-oriented programming, Java evolution, Features of Java, Java Development Kit (JDK), Java basics, keywords, constants, variables, and data types, operators and expressions, compiling and executing java Programs, operators, control flow Statements, Switch Statement, Looping statements, break and continue.

**Unit 2-** Classes, objects, and methods, declaring methods in java, constructors, static members, nesting of methods, inheritance, abstract methods and classes, array, String, and vectors.

**Unit 3**- Interfaces, defining interfaces, extending interfaces, implementing interfaces, Packages, creating packages, managing errors, and exception. Multithreaded programming.

**Unit 4-** Applets programming, Applet class, Applet and HTML, the Life cycle of an applet, graphics programming using AWT, colors, font, Event handling, Components of an event, event classes, event listener.

**Textbooks**

- Schildt Herbert, Java: The Complete Reference, 8th Edition, Tata McGraw-Hill,2011.
- E. Balagurusamy, Programming with JAVA, a Primer, 4th Edition, 2010, Tata McGraw-Hill Publishing Company Limited, Delhi.
- Dr.Rao, Nageswara. Core Java: An Integrated Approach, New Edition Kongent Solutions Inc, 2009.

## CSC 532-Dot Net Technologies

**Course Objectives**

- Identify the Basics of .Net Framework, Architecture, and programming
- Build GUI applications using .NET Framework and Visual Basics/C#.

**Learning Outcome**

- Design and Develop GUI based Applications using Vb.Net and C#.
- Integrate different components of the .net framework, including the database.

**UNIT 1-** Introduction to .Net, .Net Framework Features & Architecture, CLR, Common Type System, MSIL, Types of Assemblies, Class Libraries. Event Drive Programming, Methods and Events, Related with Mouse and Keyboard. Programming into Visual Studio, Toolbox, Properties Window, Form Designer, Form Layout, Immediate Window.

**UNIT 2-** VB.Net language, Variables, Data Types, Scope & Lifetime of a Variable, Arrays, Types of Array, Control Array, Subroutine, Functions, Passing Argument to Functions, Optional Argument, Returning Value from Function. Conditional and Loop Statement. Loading, Showing and Hiding Forms, Working with Multiple Forms, Controlling one Form within Another, Overview of C#, Structure of C# Program, C# in .Net.

**UNIT 3-** GUI Programming, Windows Form and Properties, Methods, Events, Text Box Control, Label Control, Button Control, List box, Combo Box, Checked Box, Picture Box, Radio Button, Scroll Bar, Timer Control, Common Dialog Control, Designing Menus, MDI Forms.

**UNIT 4-** ADO .Net Architecture, Create Connection, Accessing Data Using Data Adapters and Datasets, Using Command & Data Reader, Data Bind Controls, Displaying Data in Data Grid. Data Form Wizard, SQL queries, Database Using Ado.Net Object Model, Connection Object, Command Object, Add, Delete, Move & Update Records to Dataset, Executing Queries.

**Textbooks**

- Steven Holzner, Visual Basic .NET Programming Black Book, Dreamtech Publications

- Jeffrey R. Shapiro, Visual Basic.NET: The Complete Reference, McGraw Hill Education
- E. Balagurusamy, Programming in C# A primer, Tata McGraw-Hill Publishing Company Limited, Delhi.

## CSC-533 COMPILER DESIGN

**Course Outline: -** The proposed course covers various phases of Compiler which are lexical phase, syntax phase, semantic phase, code generation and code optimization. Course also covers various parsing techniques such as LEX and YACC.

**Course Objectives:-**

- To understand various models to produce tokens which are inputs syntax phase.
- Try to understand various parsing techniques such as top-down and bottom-up parsing techniques.
- Symbol Table generation and mechanisms to store information while scanning source code from various phases of the compiler.
- Semantic analysis to check the meaning of the sentences in a particular sentence.

**UNIT – I**

**Overview of Compilation:** Phases of Compilation – Lexical Analysis, Regular Grammar and regular expression for common programming language features, pass and Phases of translation, interpretation, bootstrapping, data structures in compilation – LEX lexical analyzer generator.

**Top down Parsing:** Context-free grammars, Top down parsing – Backtracking, LL (1), recursive descent parsing, Predictive parsing, Preprocessing steps required for predictive parsing.

**UNIT – II**

**Bottom up parsing:** Shift Reduce parsing, LR and LALR parsing, Error recovery in parsing, handling ambiguous grammar, YACC – automatic parser generator.

**UNIT – III**

**Semantic analysis:** Intermediate forms of source Programs – abstract syntax tree, polish notation and three address codes. Attributed grammars, Syntax directed translation, Conversion of popular Programming languages language Constructs into Intermediate code forms, Type checker.

**Symbol Tables:** Symbol table format, organization for block structures languages, hashing, and tree structures representation of scope information. Block structures and non-block structure storage allocation: static, Runtime stack and heap storage allocation, storage allocation for arrays, strings and records.

**UNIT – IV**

**Code optimization:** Consideration for Optimization, Scope of Optimization, local optimization, loop optimization, frequency reduction, folding, DAG representation.

**Data flow analysis:** Flow graph, data flow equation, global optimization, redundant sub expression elimination, Induction variable elements, Live variable analysis, Copy propagation.

**Object code generation:** Object code forms, machine dependent code optimization, register allocation and assignment generic code generation algorithms, DAG for register allocation.

**TEXT BOOKS:-**

1. Principles of compiler design -A.V. Aho . J.D.Ullman; Pearson Education.
2. Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.

**REFERENCES:**

1. lex & yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly

2. Modern Compiler Design- Dick Grune, Henry E. BAL, Cariel T. H. Jacobs, Wiley dreamtech.
3. Engineering a Compiler-Cooper & Linda, Elsevier.
4. Compiler Construction, Louden, Thomson.

**Outcomes: -**

- Students are able to understand the functionality of compiler design various phases.
- Able to learn functionalities of various phases.
- Able to design phases of compiler as a programming exercise.
- Able Design various parsing techniques such as SLR, LALR and CLR.

## CSC-534 COMPUTING FOR DATA SCIENCE

**UNIT-I**

**Computer Package**

Installation of RStudio and understanding the basic framework, Basic computational structures – Iterations and Recursions, Sequences and Arrays in R – Search and Sort Algorithms, Vectors and Matrices in R – Solving systems of linear equations, Functions in R – Plotting (2D, Contour, 3D), Differentiation, Root finding, Linear Models in R – Gradient descent, linear regression, Eigenvalue/vector computation and SVD in R ,Handling sparse matrices in R – Basic operations on sparse matrices, Probability Distributions and Random Sampling in R, Monte-Carlo Simulation in R – Implementation of case studies

**UNIT-II**

**Concept of Computations**

Algorithms – Search and Sort, Divide and Conquer, Greedy Algorithms - motivating example from setcover for large data sets. Computational Complexity – Growth of functions, Order notation, Computational Complexity -- Convergence, Error Estimation, Sparse Matrix – Store, Search and Basic operations, Binary Trees and Graphs as Computational Models.

**UNIT-III**

**Numerical Methods**

Solving system of linear equations – Gauss-Jordan (concept of pivoting), Solving non-linear equations – Newton-Raphson, Steepest Descent, Optimizing cost functions – Gradient descent, least square regression, Iterative methods in Linear Algebra – Power iteration, Eigenvalues, SVD.

**UNIT-IV**

**Computing Methodologies**

Monte-Carlo Simulation – Case studies, Sparse Matrix – Store, Search and Basic operations, Pruning and Sampling algorithms, streaming data, External sorting.

**SUGGESTED BOOKS:**

1. Software for Data Analysis – Programming with R : John M. Chambers, Springer.
2. Elementary Numerical Analysis – An Algorithmic Approach: Samuel Conte and Carl de Boor (McGraw-Hill Education).
3. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein, The MT Press (Third Edition).

## CSC-535 SOFTWARE DEFINED NETWORKS

**Prerequisites:**

1) Computer Networks.
2) High Speed Networks.

**Outline of the Course:-**

The proposed course outline is to describe advanced technology in communication based on requirement and need for industry and academia. The designed course covers protocol framework which can support Software oriented networking protocol architecture which supports virtualization. Now-a-days network virtualization play key role in creating virtual local area networks (VLAN) to control the traffic generated by enterprise networks. The proposed course covers to design a state of art technology which can support Software Defined Networking.

**Objectives: -**

- To design protocol architecture which can meet the challenges of current user demands and needs data transmission.
- To demonstrate the performance of proposed SDN supportive protocols with Open Flow enabled networks.
- To learn simulator basics this can support SDN Functionalities.
- To design and detail study of security attacks which are going to occur in SDN supportive enterprise networks.

**UNIT-I:** Introduction, Centralized and Distributed Control and Data Planes, Introduction What Do They Do? Distributed Control Planes Centralized Control Planes Conclusions.

Open Flow: Introduction, Hybrid Approaches Conclusions SDN Controllers Introduction General Concepts Layer 3 Centric Plexxi Cisco One PK Conclusions.

**UNIT-II: Network Programmability:** Introduction, the Management Interface the Application-Network DivideModern Programmatic Interfaces, I2RSModern Orchestration Data Center Concepts and Constructs.

**Introduction:** The Multitenant Data Centerthe Virtualized Multitenant Data Center SDN Solutions for the Data Center Network VLANsEVPN, VxLan, NVGRE, Conclusions, Network Function Virtualization Introduction Virtualization and Data Plane I/O Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV Work, Conclusions.

**UNIT-III:** Network Topology and Topological Information Abstraction Introduction, Network Topology, Traditional Methods, LLDP, BGP-TE/LS,ALTO,I2RS Topology Building an SDN Framework, Introduction, Build Code First; Ask Questions Later, The Juniper SDN Framework, IETF SDN Framework(s), Open Daylight Controller/Framework, Policy, Conclusions.

**UNIT-IV:** Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Introduction, Bandwidth Calendaring, Big Data and Application Hyper-Virtualization for Instant CSPF, Expanding Topology, Conclusion, Use Cases for Data Center Overlays, Big Data, and Network Function Virtualization, Introduction, Data Center Orchestration, Puppet (DevOps Solution), Network Function Virtualization (NFV), Optimized Big Data, Conclusions.

**Text Books:**

1. SDN: Software Defined Networks An Authoritative Review of Network Programmability Technologies By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media Final Release Date: August 2013 Pages: 384.
2. Software Defined Networks: A Comprehensive Approach Paperback – Import, 30 Jun 2014by Paul Goransson (Author), Chuck Black (Author)
3. Software Defined Networking with Open Flow by SiamakAzodolmolky (Author).

**Outcomes:**

- Understanding between conventional networks and SDN Supportive networks to provide high throughput based on user needs.
- Understanding of Network Virtualization and requirements and changes in hardware design point of view.
- Virtual LAN supportive protocols and its operations to enhance the Quality of Service parameters.
- Understand and identify security vulnerabilities in open flow based networks. Understand prevention mechanism for well-known security attacks in conventional networks.
- Adaptive machine learning techniques to prevent security attacks in SDN.

## CSC-536 MOBILE COMPUTING

**Pre-requests to the Course:**

- Computer Networks.
- Data Communication.

**Course Outline: -** The proposed course introduces the fundamentals of Wireless Communication, issues challenges in wireless communication. The course detail explanation of various generation of Wireless Networks generation those are 2G, 3G and 4G. The proposed course covers technical details layer wise, which are Physical layer parameters such as modulation, demodulation and multiplexing techniques. MAC Layer issues such as various channel accessing schemes those are pure aloha, slotted aloha and p-persistent. The course covers in detail technical details such as packet formats of IEEE-802.11 standards for Medium accesses control to avoid collisions. Network Layer issues and challenges and details of various routing algorithms such as AODV, DSR and TORA protocols. Various TCP Enhancements for existing TCP Version which are TCP-RENO, Tahoe and SACK protocols for reliable and end-to-end communication for improving the performance.

**Objectives:**

- The objective is to understand various generations of Mobile Communication such as 2G, 3G and 4G.
- To study various issues and challenges in Physical layer such as analog to digital conversion and various modulation and demodulation techniques.
- Illustration of various physical layer issues like inter symbol interference, ISI Mitigation. Physical layer parameter such as refraction, reflection and signal to noise ratio to improve the quality.
- Demonstrate the Various MAC Layer challenges in Wireless Networks when compared to structured Networks.
- Study of various Routing Layer Protocols suitable for Wireless Ad-Hoc Networks and Protocol operations.
- Study of various TCP Layer issues and challenges for Wireless Networks.

**UNIT-I**

Introduction, Applications, A short history of wireless Communication, A market for Mobile Communications, Some open research topics, A Simple Reference Model. Overview, Wireless Transmission, Frequency for radio transmission, Regulations, Signals, Antennas, Signal Propagation, Path Loss of radio Signals, Additional signal Propagation effects, Multi-path Propagation. Multiplexing, Modulation, Spread Spectrum.

**UNIT-II**

Medium Accesses Control, Motivation for Specialization MAC, Hidden and exposed terminals, near and Far Terminals, SDMA, FDMA, TDMA, CDMA.

**UNIT-III**

Wireless LAN, IEEE 802.11: System Architecture, Protocol architecture, Physical Layer, MAC Control Layer, MAC Management, 802.11b, 80.11a,HIPERLAN: , Bluetooth : User Scenario, Architecture, Radio Layer, Link Manager Protocol, L2CAP, SDP, IEEE 802.15.

**UNIT-IV**

Mobile Network Layer, Mobile IP, Dynamic Host Configuration Protocol, Mobile Ad-Hoc Networks, Mobile Transport Layer, Classical TCP Improvements.

**Text Books:**

- Mobile Communications by JochenH.Schiller.
- Mobile Computing, Technology Applications and Service Creation by Asoke K Talukder and Roopa R Yavagal.

**Reference Books:**


- Stojmenovic and Cacute**,** "Handbook of Wireless Networks and Mobile Computing", *Wiley*, 2002, ISBN0471419028.
- Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004,

- Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden, Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005.

## CSC-537 HUMAN COMPUTER INTERACTION

Human Computer Interaction deals with how humans interact with the Computer System. The course will uncover how designs are aesthetically done, details of ergonomics and evaluation techniques

**Course Objectives**

- Demonstrate how input-output channels work.
- To introduce the details of interaction and design.
- To discuss different evaluation techniques and cognitive methods.
- Laboratory exercises to be covered in Lab sessions.

The Human: input-output channels, Human memory, thinking, emotions, individual differences, psychology and the design of interactive systems.

The Computer: Text entry devices with focus on the design of key boards, positioning, pointing and drawing, display devices.

The Interaction: Models of interaction, ergonomics, interaction styles, elements of WIMP interfaces, interactivity, experience, engagement and fun. Paradigms for Interaction.

Design Process: The process of design, user focus, scenarios, navigation design screen design and layout, iteration & prototyping. Usability Engineering

Design rules: Principles to support usability, standards, guidelines, rules and heuristics, HCI patterns.

Evaluation Techniques: Definition and goals of evaluation, evaluation through expert analysis and user participation, choosing an evaluation method.

Cognitive methods: Goals and task hierarchies, linguistic models, challenges of display based systems, physical and device models, cognitive architectures.

Communications and collaborations models: Face to Face communication, conversations, Text based communication, group working.

**BOOK:**
Human Computer Interaction; Alan Dix et.al, 3rd ed., Pearson.

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

- Develop better interfaces that are more usable.
- Demonstrate understanding of design guidelines, principles and standards.

## CSC-538 FRACTAL THEORY

**Objective:** After completion of this course students will be able to draw fractals and develop understanding of chaos.

**Unit 1**: The basic concepts of geometric iteration, principle of feedback processes Fundamentals of Fractals, Types of fractal (mathematical and nature), self-similarity, fractal dimension, multiple

reduction copy machines, the chaos game, fractals in nature, and decoding fractals. Chaos wipes out every computer. Chaos in (nature and Math).

**Unit 2:** Standard mathematical fractals (Seirpinski carpet ,gasket, cantor dust , koch curve etc), limits and self similarity, Fractal dimension, Types of fractal dimension, implementation of standard fractal and calculating their dimensions. Affine transformation, Transformations, composing simple transformations, classical fractals by IFS, drawing the classical fractals using IFS.

**Unit 3:** Deterministic Chaos, analysis of chaos, periodic points, sensitivity, fixed points, logistic map, sensitivity dependence of initial condition, implementation and detailed analysis of logistic map (mathematically and in real life). L-systems, turtle graphics (graphical interpretation of L-Systems), Networked MRCMs, L-Systems tree and bushes, Growing classical fractals with L-Systems and their implementation.

**Unit 4:** Julia set ( Fractal basin boundaries), complex numbers, escape and prisoners set, filled Julia set, Quaternion Julia set, exploring Julia sets by varying complex numbers.

Mandelbrot set, geometric features and properties , study structure of Mandelbrot set. Implementation of Julia set and Mandelbrot set.

Project: Students will complete a final creative project that involves researching an application to fractals and chaos. Students will create something to go along with the project, like artwork, a short story, or a computer generated image.

**Learning Outcomes:**

- Iterated Function System
- Escape-time Fractals
- Behavior of Chaotic logistic map
- L-system

## CSC-539 SOFTWARE AGENTS AND SWAM INTELLGENCE

- Brief Introduction to S/W agent Technology
- Agent & AI
- Practical design of intelligent agent System
- Intelligent Agent application Area
- Biological Foundations of Swarm Intelligence
- Swarm Intelligence in Optimization
- Routing protocols for next-generation network Inspired by collective Behaviours of insects societies: An overview
- An Agent based approach to self-organised production
- Organic Computing and Swarm Intelligence

**BOOKS:**

1. Intelligent software agents: foundations and applications by Walter Brenner, Rudiger Zarnekow, Hartmut Witting Springer, 1998.

2. Swarm intelligence: introduction and applications By Christian Blum, Daniel Merkle., Springer 2008

## CSC-540: INTERNET OF THINGS (IoT)

**Course Outline:**
Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems.

**Course Objectives**
To teach state of art of wireless sensor networks
- To discuss importance of communication protocols.
- To teach challenges in routing protocol and overview of transport layer protocols.
- To teach basics of Internet of Things.

**Unit I:** Introduction: Overview of Wireless Sensor Networks – Characteristics, Applications, Design objectives, challenges. Technological Background – MEMS Technology, Hardware and Software Platforms, Wireless Sensor Network Standards. Sensor network architectures and protocol stack.
**Unit II:** Medium Access Control: Fundamental MAC protocols, Objectives of MAC design, Energy efficiency in MAC design, MAC protocols for wireless sensor networks – Contention based protocols, Contention free protocols, Hybrid protocols.
**Unit III:** Network and Transport Layer: Fundamentals and Challenges of Routing protocol, Overview of Routing protocols: Location-aided protocols, Layered and In-network processing based protocols, Data centric and multipath Protocols. Data aggregation mechanisms. Traditional transport protocols, Transport protocols for sensor networks.
**Unit IV:** Basics on Internet of Things: Introduction, Reference Model and architecture, IoT reference Model. IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
**Text/References:**
1. Jun Zheng, Abbas, " Wireless sensor networks A networking perspective", WILEY, 2009.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, ―Wireless Sensor Networks-Technology, Protocols, And Applications‖, John Wiley, 2007
3. Thomas Haenselmann, ―Wireless Sensor Networks: Design Principles for Scattered Systems‖, Oldenbourg Verlag, 2011
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st 9 Edition, VPT, 2014.
5. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols: CRC Press
6. F. Zhao and L. Guibas, Wireless Sensor Network: Information Processing Approach, Elsevier.
7. A. Hac, Wireless Sensor Network Designs, John Wiley & Sons 8. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

**Learning Outcomes**
- At the end of the course students can be able to:
- Understand technological background of sensor networks.
- Able to design applications using Raspberry Pi.

- Design and apply various existing routing protocols of sensor networks.
- Design the architecture and reference model of IoT.