M.Sc. (Computer Science)

Core Courses

OPERATING SYSTEMS

Course Code	CSC81DC00104	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	I	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Course		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students.*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives :

- To learn the fundamentals of Operating Systems.
- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS.
- To know the components and management aspects of concurrency management
- To understand the services provided by and the design of an operating system.
- To understand the structure and organization of the file system.
- To understand what a process is and how processes are synchronized and scheduled.

Course Learning Outcomes:

- Analyze the structure of OS and basic architectural components involved in OS design
- Analyze and design the applications to run in parallel either using process or thread models of different OS
- Analyze the various device and resource management techniques for timesharing and distributed systems.
- Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
- Interpret the mechanisms adopted for file sharing in distributed Applications.
- Conceptualize the components involved in designing a contemporary OS.

Course Contents :

UNIT I

Introduction: Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.

(10 % Weightage)

UNIT II

Processes: Concept of processes, process scheduling, operations on processes, inter-process communication, Communication in Client-Server Systems, overview & benefits of threads.

Process scheduling: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms.

(25 % Weightage)

UNIT III

Process Synchronization: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

(10 % Weightage)

UNIT IV

Deadlock: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

(20 % Weightage)

UNIT V

Memory Management: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation.

(15 % Weightage)

UNIT VI

Virtual Memory: background, demand paging, page replacement, page replacement algorithms, allocation of frames, thrashing.

(10 % Weightage)

UNIT VII

File Systems: File concept, access methods, directory structure, Disk Management: disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN)

(10 % Weightage)

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Introduction: Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.
5-8	**Processes:** Concept of processes, process scheduling, operations on processes, inter-process communication, Communication in Client-Server Systems, overview & benefits of threads.
9-15	**Process scheduling:** scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms.
16-20	**Process Synchronization:** background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
21-28	**Deadlock:** system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.
29-34	**Memory Management:** background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation.

35-40	**Virtual Memory:** background, demand paging, page replacement, page replacement algorithms, allocation of frames, thrashing.
41-45	**File Systems:** file concept, access methods, directory structure, Disk Management: disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN)
15 Hours	***Tutorials***

Essential Readings:

1. Operating System Principles by Silberschatz A. and Peterson J. L., Wiley
2. Operating System by Haldar and Aravind, Pearson
3. Operating Systems by Dhamdhere, TMH
4. Operating Systems by Deitel, Deitel & Choffnes.
5. Modern Operating Systems by Tanenbaum Pearson Education
6. Operating System by Stallings Pearson Education.

DATA STRUCTURE AND ALGORITHMS

Course Code	CSC81DC00204	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	I	**Contact Hours**	45 (L) + 30 (P) Hours
Course Type	Discipline Based Core		
Nature of the Course	Theory/Practical		
Special Nature/ Category of the Course (*if applicable***)**	Skill Based		
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students, individual and group drills, group and individual field based assignments followed by workshops and seminar presentation.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades)		

	● 70% - End Term External Examination (University Examination)

Course Objectives

- Ability to analyze a problem and determine the appropriate data structure for the problem.
- Understand the importance of data structures in advanced programming.
- Understand and analyze elementary algorithms: sorting, searching and hashing.
- To acquaint the students with the basic concepts in Data Structures.
- To develop skills and competencies in constructing and standardizing a Graph.
- To make the students understand how various requirements data set can be handled.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Differentiate among primitive and non-primitive data type.
- Differentiate among Linear and Non-linear data structure.
- Plan and execute (dry run) various types of data structure.
- Examine the goodness of a particular data structure by analyzing its properties..
- Pick an appropriate data structure as per the requirements and objectives of their problem.
- Become prepared for Lab implementation of various data structure.

Course Contents

UNIT I: Definition and Complexity Analysis (13% Weightage)

- Introduction to problem solving, Some concepts of object oriented programming
- Concepts of data types. Elementary structures, Data types and their interpretation.

- Concepts of analysis of algorithm,, Big O- Notation, Big-omega and Big-theta notations.

UNIT II: Array, Stack and Queue (25% Weightage)

- **Arrays:**
  - Types
  - Memory representation
  - Address translation
  - Functions of single and multi-dimensional arrays with examples.
- **Stacks**
  - Introduction to stack
  - Representation
  - Primitive operations on stack
  - Uses and Applications
  - Prefix notation, Infix notation, postfix notation: conversion and evaluation
- **Queue:**
  - Introduction to queues
  - Primitive operations on the queues
  - Circular queue
  - Priority queue
  - Applications of queue.

UNIT III: Searching and Sorting (25% Weightage)

- **Searching:** Terminology**,** Linear Search, binary search
- **Sorting:** Terminology, Bubble Sort, Insertion Sort, Selection Sort, Quick sort. Merge sort. Introduction to Heap and Heap Sort

UNIT IV: Linked List and Trees (20%Weightage)

- **Linked List:** Introduction to the linked List, basic operations on linked list, doubly linked list, circular linked list, application of linked List.
- **Trees** - Basic terminology, binary trees, basic operation on binary tree, traversal of binary trees - In order, pre-order & post order, application of binary tree, threaded binary tree, B-tree & height balanced tree.

UNIT V: Graphs **(17% Weightage)**

Introduction to graphs, Graph traversal-depth first search & breadth first search, spanning trees, Minimum spanning tree and shortest path algorithm.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Introduction to problem solving, concepts of object oriented programming
3-5	Concepts of data types. Elementary structures, Data types and their interpretation
6-8	Concepts of analysis of algorithm,, Big O- Notation, Big-omega and Big-theta notations.
9-11	**Arrays:** Types**,** Memory representation**,** Address translation**,** Functions of single and multi-dimensional arrays with examples.
12-15	**Stacks:** Introduction to stack**,** Representation**,** Primitive operations on stack**,** Uses and Applications**,** Prefix notation, Infix notation, postfix notation: conversion and evaluation
16-20	**Queue:** Introduction to queues**,** Primitive operations on the queues**,** Circular queue**,** Priority queue**,** Applications of queue.
21-22	**Searching:** Terminology**,** Linear Search, binary search
22-27	**Sorting:** Terminology, Bubble Sort, Insertion Sort, Selection Sort, Quick sort. Merge sort. Introduction to Heap.
28-33	**Linked List:** Introduction to the linked List, basic operations on linked list, doubly linked list, circular linked list, application of linked List.
34-39	**Trees** - Basic terminology, binary trees, basic operation on binary tree, traversal of binary trees - In order, pre-order & post order, application of binary tree, threaded binary tree, B-tree & height balanced tree.
40-45	Introduction to graphs, Graph traversal-depth first search & breadth first search, spanning trees, Minimum spanning tree and shortest path algorithm.
15 Hours	*Tutorials*
Essential Readings:	

- Introduction to Algorithm, 2e, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, PHI
- Alfred V. Aho, John E. Hopcroft, Jeffery D. Ullman, ―Data Structures and Algorithms‖ Addison Wesley, 1983.
- Beginning Algorithms by Simon Harris, James Ross, Wiley India.
- Fundamentals of Computer Algorithms by E.Horowitz and S. Sahni, Galgotia
- "Art of Computer Programming, Vol-1" by Knuth, Pearson Education
- "An Introduction of Computer Science –An Algorithmic Approach" by J. P. Tremblay and R.B. Bunt., TMH
- "An Introduction to Data Structures and Non-Numeric Computation" by P G. Brillinger & D. J. Cohen.

COMPUTER NETWORKS

Course Details			
Course Title: COMPUTER NETWORKS			
Course Code	CSC81DC00304	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	I	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core	**Nature of the Course**	Theory
Methods of Content Interaction	Lecture, Tutorials, Assignments, Group discussion; self-study, seminar, presentations by students.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To understand the fundamental concepts of Computer Networking.
- To theoretically visualize the message transmission process through Computer Networks.
- To familiarize students with basic terminology of Computer Networking area.
- To familiarize students with advanced networking concepts so that they become prepare for expertise in specific networking area.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Understand basic computer network technology.
- Identify different network protocols.
- Analyze the growth of networking from history to present time.
- Understand different OSI Layers and their interconnection.
- Understand different type of networking devices and their uses.

Course Contents:

UNIT I: Computer Networks and the Internet (20% Weightage)

About The Internet its Protocols, the Network Edge, the Network Core, Access Networks and Physical Media, Delay and Loss in Packet-Switched Networks, Protocol Layers and Their Service Models, Internet Backbones, NAPs and ISPs, A Brief History of Computer Networking and the Internet.

UNIT II: Application Layer: (20% Weightage)

Principles of Application-Layer Protocols, the World Wide Web: HTTP, File Transfer: FTP, Electronic Mail in the Internet, the Internet's Directory Service: DNS, Socket Programming with TCP, Socket Programming with UDP.

UNIT III: Transport Layer (20 % Weightage)

Transport-Layer Services and Principles, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable of Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control.

UNIT IV: Network Layer and Routing (20%Weightage)

Introduction and Network Service Model, Routing Principles, Hierarchical Routing, Internet Protocol, Routing in the Internet, what is Inside a Router, Introduction to IPv6, and Multicast Routing.

UNIT V: Link Layer and Local Area Networks (20% Weightage)

The Data Link Layer: Introduction, Services, Error Detection and Correction, Multiple Access Protocols and LANs, LAN Addresses and ARP, Ethernet, Hubs, Bridges and Switches, Wireless LANs: IEEE 802.11, the Point-to-Point Protocol.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-3	About The Internet its Protocols, the Network Edge, the Network Core, Access Networks and Physical Media
4-9	Delay and Loss in Packet-Switched Networks, Protocol Layers and Their Service Models, Internet Backbones, NAPs and ISPs, A Brief History of Computer Networking and the Internet.
10-14	Principles of Application-Layer Protocols, the World Wide Web: HTTP, File Transfer: FTP, Electronic Mail in the Internet,
15-18	the Internet's Directory Service: DNS, Socket Programming with TCP, Socket Programming with UDP.
19-22	Transport-Layer Services and Principles, Multiplexing and Demultiplexing, Connectionless Transport: UDP,
23-27	Principles of Reliable of Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control.
28-31	Introduction and Network Service Model, Routing Principles, Hierarchical Routing, Internet Protocol
32-35	Routing in the Internet, what is Inside a Router, Introduction to IPv6, and Multicast Routing.

36-40	The Data Link Layer: Introduction, Services, Error Detection and Correction, Multiple Access Protocols and LANs, LAN Addresses and ARP,
41-45	Ethernet, Hubs, Bridges and Switches, Wireless LANs: IEEE 802.11, the Point-to-Point Protocol
15 Hours	*Tutorials*

Essential Readings:

1. Computer Networking, by Kurose & Ross, Pearson Education
2. Data Communications and Networks, by Forouzan, TMH
3. Computer Networks, by Tanenbaum, Pearson Education

Suggested Readings:

1. Computer Network, A system approach; Larry L. Peterson & Bruce. S. Davie, the Morgan Kaufmann Series.
2. Data & Computer Communication, by William Stallings, Pearson Education
3. Networking, All-in-one Desk Reference, 10 Books in 1 by Doug lowe, Wiley

INDIAN KNOWLEDGE SYSTEM IN COMPUTER SCIENCE

Course Details			
Course Title: INDIAN KNOWLEDGE SYSTEM IN COMPUTER SCIENCE			
Course Code:	CSC81DC00402	**Credits**	2
L + T + P	2 +0 +0	**Course Duration**	One Semester
Semester	I	**Contact Hours**	30 (L)
Course Type	Discipline-Based Core	**Nature of the Course**	Indian Knowledge System
Methods of Content Interaction	Lectures, Assignments, Class Tests, Student Presentations, Self-study		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Prerequisites: No prerequisite required

Course Objectives

- To introduce students to the contribution of Indians in the area of Computation
- To introduce them to some eminent Indian scientists and their contribution in the field
- To introduce make students aware about the ecosystem exist in India

Course Learning outcomes

After the course the students:

- Would become familiar with the contribution of India in the domain.
- would know about Indians who have contributed significantly to the domain.
- would become familiar with the research and development ecosystem that exists in India in computer science.

Course Contents:

UNIT 1 Contribution of Indians to Computation (50% Weightage)

Invention of Zero, Decimal and Binary Number System, Fibonacci Series and Golden Ratio and their history, biography of Indians and their contribution to Computer Science

UNIT 2 Ecosystem for Computer Science in India (50% Weightage)

Indian IT industry and its contribution to Computer Science, Introduction to R&D entities in India and their contribution to computer science

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**

1-4	Invention of Zero, Decimal and Binary Number System
5-8	Fibonacci Series and Golden Ratio and their history
9-15	biography of Indians and their contribution to Computer Science
16-22	Indian IT industry and its contribution to Computer Science
22-30	Introduction to R&D entities in India and their contribution to computer science

Suggested Readings:

1. The Aryabhatiya of Aryabhata: An Ancient Indian Work on Mathematics and Astronomy, Walter Eugene Clark, Kessinger Pub Co, ISBN-10 : 1425485995
2. Number Words and Number Symbols: A Cultural History of Numbers, Karl Menninger, Dover Publications, 1992
3. Carl B. Boyer, Uta C. Merzbach Boyer, C. B. History of Mathematics. Wiley; 2nd edition
4. D. Knuth. The Art of Computer Programming. Volume 2, 3rd Ed. Addison–Wesley. pp. 194–213, "Positional Number Systems".
5. Georges Ifrah. The Universal History of Numbers : From Prehistory to the Invention of the Computer, Wiley, 1999. ISBN 0-471-37568-3.
6. Ram, B. (December 2009). Computer Fundamentals, Architecture & Organisation. New Age International

Additional/Advanced/Further Readings:

1. Livio, M. The Golden Ratio: The Story of Phi, the World's Most Astonishing Number. New York: Broadway Books, 2002.
2. A Mathematical History of the Golden Number, Roger Herz-Fischler, Dover Publications; Unabridged edition

3. https://math.temple.edu/~reich/Fib/fibo.html
4. https://fibonacci.com/golden-ratio
5. https://mathworld.wolfram.com/GoldenRatio.html
6. The Divine Proportion: A Study in Mathematical Beauty
7. Bhatkar, V.P. (April 1994). "PARAM parallel supercomputer: architecture, programming environment, and applications". Proceedings of 8th International Parallel Processing Symposium
8. https://www.serc.iisc.ac.in/supercomputer/for-traditional-hpc-simulations-param-pravega

HUMAN VALUES AND ETHICS FOR COMPUTER PROFESSIONALS

Course Details			
Course Title: HUMAN VALUES AND PROFESSIONAL ETHICS			
Course Code	CSC81DC00502	**Credits**	2
L + T + P	2 + 0 + 0	**Course Duration**	One Semester
Semester	I	**Contact Hours**	30 (L)
Course Type	Discipline Based Core Course		
Nature of Course	Theory		
Special Nature of Course	Value Based		
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To acquaint the students with foundational knowledge of ethics, human values and moral values.
- To develop in a sense of responsibility as an individual to nature and society.
- To develop holistic perspective among students.

- To develop ethical and professional conduct.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Students will develop ability in itself for self-exploration.
- Incorporate technical education with human values.
- Students will be able do verification on basis of natural acceptance and experimental validation.
- Students will be able do understand harmony between different components.
- Students will be able do understand ethical professional behaviour.

Course Contents:

UNIT I: Fundamentals: (30% Weightage)

Value Education: Definition, Need, Understanding value education, Self-exploration, continuous happiness and prosperity, Understanding human being as coexistence of self and body

UNIT II: Harmony (40% Weightage)

Harmony in Self (I) - understanding self, harmony in body, harmony in family – understanding values in human relationship, harmony in society – concept of world family, harmony in nature- mutual fulfilment, harmony in existence.

UNIT III: Ethics and Professionalism (30% Weightage)

Basis for values and ethical conduct, ethics in light of right understanding, vision of holistic technologies, production and management, concept of holistic alternative.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Value Education: Definition, Need, Understanding value education
5-9	continuous happiness and prosperity, Understanding human being as coexistence of self and body

10-15	Harmony in Self (I) - understanding self, harmony in body,
16-19	harmony in nature- mutual fulfilment, harmony in nature – coexistence.
20-21	Basis for values and ethical conduct
21-22	ethics in light of right understanding
23-28	vision of holistic technologies, production and management
28-30	concept of holistic alternative

Essential Reading :

1. R. R. Gaur, R Sanghal, G P Bagaria, 2009, "A Foundation Course in Human Values and Professional Ethics" Excel Books Private Limited, New Delhi

Additional/Advance/Further Readings:

1. R. R. Gaur, R Sanghal, G P Bagaria, 2009, *"Teacher's Manual: A Foundation Course in Human Values and Professional Ethics"* Excel Books Private Limited, New Delhi
2. Sussan George, 1976, "How the Other Half Dies", Penguin Press, Reprinted 1986, 1991
3. A N Tripathy, 2003, "Human Values", New Age International Publisher
4. E G Seebaur & Robert L Berry, 2000, "Fundamental of Ethics for Scientists and Engineers", Oxford University Press

DATABASE MANAGEMENT SYSTEM

Course Details			
Course Title: DATABASE MANAGEMENT SYSTEM			
Course Code:	CSC82DC00604	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 30 (L) Hours
Course Type	Discipline Based Core	**Nature of the Course**	Theory/Skill Based
Methods of Content Interaction	Lecture, Tutorials,Class Tests, Self-study, Home Assignments, Mini Project		

Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)

Course Objectives

- To enable students understand the need of database, its components and their functions and the stakeholders.
- To enable students understand how to design a good logical design of a database using E-R Model
- To enable students understand fundamental of Relational Model with details, on which most of the modern database software are based.
- To enable students understand the process of normalization to mathematically evaluate your logical schema of the database, remove information access anomalies and minimize redundancy.
- To enable students understand various integrity constraints that are imposed on databases to ensure consistency in databases.
- To enable students understand fundamentals of the SQL, a standard query language that is used to fetch desired information from the database.
- To make students aware about the concurrent transactions, their issues and protocols to ensure the ACID properties of transaction.
- To make students aware about how each SQL query is evaluated efficiently by the database management system

Course Learning outcomes

- After the course the students will be able to design the logical schema of the database using E-R modelling.
- They will be able to refine the design of the database to minimize the redundancy and information access anomaly.
- They will be able to implement database and write queries to fetch desired information from the database.

Course Contents:

UNIT I: Introduction to Database Management System (15% Weightage)

Purpose of database systems, View of data, Data models, Database administrator, database users, overall system structure, Classification of Database Management System, Three-Schema Architecture.

UNIT II: Data Modelling (20% Weightage)

Entity- Relationship Model: Basic concepts, design issues, mapping constraints, keys, E-R diagram, weak entity sets, Extended E-R features, Design of an E-R database schema, reduction of an E-R schema to tables.

UNIT III: Relational Model (25% Weightage)

Structure of relational databases, Relational algebra, extended relational-algebra operations, modification of the database.

Relational Languages: Background, basic structure, set operations, aggregate functions, null values, nested sub-queries, joined relations

Integrity Constraints: Domain constraints, referential integrity, functional dependencies.

UNIT IV: Relational Database Design (20% Weightage)

Pitfalls in relational database design, Decomposition, Normalization using functional, multi-valued and join dependencies, domain key normal form and alternative approaches to database design.

UNIT V: Transactions (20% Weightage)

Transaction concept, transaction state, System log, Commit point, Desirable Properties of a Transaction, Concurrent executions, serializability, recoverability, Implementation of isolation, Testing for serializability, Introduction to Security and Integrity in database.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Purpose of database systems, View of data, data models
3-4	Database administrator, database users, overall system structure, Classification of Database Management System, Three- Schema Architecture.

5-10	Entity- Relationship Model, Basic concepts, design issues, mapping constraints, keys, E-R diagram, weak entity sets
10-12	Extended E-R features, design of an E-R database schema, reduction of an E-R schema to tables.
12-16	*Relational Model:* Structure of relational databases, relational algebra, extended relational-algebra operations, modification to the database.
16-20	*Relational Languages (SQL):* Background, basic structure, set operations, aggregate functions, null values, nested sub-queries, joined relations
21-23	*Integrity Constraints:* Domain constraints, referential integrity, functional dependencies.
24-33	*Relational Database Design:* Pitfalls in relational database design, decomposition, normalization using functional, multi-valued and join dependencies, domain key normal form and alternative approaches to database design.
34-43	*Transactions:* Transaction concept, transaction state, System log, commit point, Desirable Properties of a Transaction, concurrent executions, serializability, recoverability, implementation of isolation, Testing for serializability.
44-45	Introduction to Security and Integrity in database.
15 Hours	*Tutorials*

Essential Readings:

1. Database System Concepts, 3rd edition, by A. Silberschatz, H. F. Korth, & S. Sudarshan, McGraw Hill.
2. Fundamental of Database Systems, by Elmasri, Navathe, Somayajulu, and Gupta, Pearson Education.

Suggested Readings:

1. An Introduction to Database Systems, Bipin C Desai , Galgotia Publications New Delhi, ISBN-13: 978-8175157521
2. SQL The Complete Reference, 3rd Edition, by James Groff , Paul Weinberg, Andy Oppel, McGraw Hill Education, ISBN-13: 978-1259003882
3. An Introduction to database system by C.J. Date, A. Kannan, S. Swamynathan, Pearson Education.
4. Database management System, by Rajesh Narang, PHI

5. Database Systems by Rob, Coronel, Galgotia Publication.

OBJECT ORIENTED PROGRAMMING METHODOLOGY

Course Code	CSC82DC00704	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	II	**Contact Hours**	45 (L) + 30 (P) Hours
Course Type	Discipline Based Core		
Nature of the Course	Theory/Practical		
Special Nature/ Category of the Course (*if applicable*)	Skill Based		
Methods of Content Interaction	Lecture, Tutorials, self-study and assignments.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- Main objective of the course is to learn object oriented programming and advanced C++ concepts.
- Improve problem solving skills using object oriented programming concept.
- Ultimate goal is to make a good programmer that uses object oriented approach.

Course Learning Outcomes

After going through this course a student should:

- Be able to explain the difference between object oriented programming and procedural programming.
- Be able to write program using classes and objects, operator overloading, dynamic memory allocation, inheritance and polymorphism, exception handling, etc.

- Be able to develop C++ classes using appropriate encapsulation and design principles.
- Be able to apply object oriented techniques to solve bigger computing problems.

Prerequisites: Programming in C.

Course Contents:

UNIT I **(15% weightage)**

Introduction to C++: Object Oriented Technology, Advantages of OOP, Input-output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derived data types, The *void* data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

UNIT II **(20% weightage)**

Control Structures: Decision making statements like *if-else, Nested if-else, goto, break, continue, switch case,* Loop statement like *for* loop, *nested for* loop, *while* loop, *do-while* loop.
Functions: Parts of Function, User-defined Functions, Value-Returning Functions, *void* Functions, Value Parameters, Function overloading, Virtual Functions.

UNIT III **(25% weightage)**

Classes and Data Abstraction: Structure in C++, Class, Built-in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects(Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.
Overloading & Templates: Operator Overloading, Function Overloading, Function Templates, Class Templates.

UNIT IV **(25% weightage)**

Inheritance: Single & Multiple Inheritance, Virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.
Pointers and Arrays: Void Pointers, Pointer to Class, Pointer to Object, The *this*pointer, Void Pointer, Arrays.

UNIT V **(15% weightage)**

Exception Handling: The keywords *try, throw and catch*, Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), and Stack Unwinding.

Lab: 30 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	**Introduction to C++:** Object Oriented Technology, Advantages of OOP, Input-output in C++, Tokens, Keywords, Identifiers, Data Types C++
5-7	Derived data types, The *void* data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings
8-11	**Control Structures:** Decision making statements like *if-else, Nested if-else, goto, break, continue, switch case,* Loop statement like *for* loop, *nested for* loop, *while* loop, *do-while* loop.
12-15	**Functions:** Parts of Function, User-defined Functions, Value-Returning Functions, *void* Functions, Value Parameters, Function overloading, Virtual Functions.
16-19	**Classes and Data Abstraction:** Structure in C++, Class, Built-in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects(Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.
20-25	**Overloading & Templates:** Operator Overloading, Function Overloading
26-29	Function Templates, Class Templates
30-34	**Inheritance:** Single & Multiple Inheritance, Virtual Base class
35-38	Abstract Class, Pointer and Inheritance, Overloading Member Function.
39-40	**Pointers and Arrays:** Void Pointers, Pointer to Class, Pointer to Object, The *this*pointer, Void Pointer, Arrays.

41-45	**Exception Handling:** The keywords *try, throw and catch*, Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), and Stack Unwinding.
30 Hours	*Lab*

Essential Readings:

1. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education.
2. Mastering C++, 1/e by Venugopal, Tata McGraw Hill.
3. Object Oriented Programming with C++, 3/e by E. Balagurusamy, Tata McGraw Hill.
4. Starting Out with Object Oriented Programming in C++, by Tony Gaddis, Wiley India.

Further Readings::

1. The C++ Programming language 3/e by BjarneStroustrup, Pearson Education.
2. C++ How to Program, 4e, by Deitel, Pearson Education.
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippman, JoseeLajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.
6. Programming with C++, 2/e by Ravichandran, Tata McGraw Hill.

SOFTWARE ENGINEERING

Course Code	CSC82DC00804	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	II	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Course		
Nature of the Course	Theory		
Special Nature/ Category of the Course (*if applicable*)	Skill Based		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		

Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)

Course Objectives :

- Realize the importance of systematic and disciplined approach to software development.
- Choose the appropriate software process model for a given problem.
- Identify the requirements for given problem through customer interaction.
- Analyze the customer requirements using different problem Analysis methods, create the Software Requirement Specification Document (SRS) and demonstrate the skill to develop high quality software.
- Discuss the importance of testing in s/w development life cycle.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to:

- Explain the importance of systematic approach in engineering the software.
- Estimate the cost of choosing a particular software process model.
- Recognize software requirements through customer interaction.
- Write software requirements specification (SRS) document.
- Distinguish between different tests that are to be done to validate software.

Prerequisites: Basic of Computer science, 'C' Programming concept.

Course Contents:

UNIT I

Introduction: S/W Engineering Discipline-Evolution and Impact, Program vs S/W Product, Emergence of S/W Engineering.

(10 % Weightage)

UNIT II

Software Life Cycle Models: Waterfall, Prototyping, Evolutionary, Spiral models and their comparisons.

(10 % Weightage)

UNIT III

Software Project Management: Project Manager responsibilities, Project Planning, Project Size estimation Metrics, Project estimation Techniques, COCOMO, Staffing Level Estimation, Scheduling, Organization & Team Structures, Staffing, Risk Management.

(20 % Weightage)

UNIT IV

Requirements Analysis and Specification: Requirement Gathering and Analysis, SRS

(10 % Weightage)

UNIT V

Software Design: Overview, Cohesion and Coupling, S/W Design Approaches, Object-Oriented vs. Function-Oriented Design.

(10 % Weightage)

UNIT VI

Coding and Testing: Coding, Code Review, Testing, Unit Testing, Black Box Testing, White-Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing, General Issues.

(20 % Weightage)

UNIT VII

Software Reliability and Quality Management: S/W Reliability, Statistical Testing, S/W Quality, S/W Quality Management System, ISO 9000, SEI CMM, Personal Software Process, Six Sigma.

(10 % Weightage)

UNIT VIII

Software Maintenance: Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.

(10 % Weightage)

Tutorial: 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion **(Each session of 1 Hour)**	**Unit/Topic/Sub-Topic**
1-2	**Introduction:** S/W Engineering Discipline-Evolution and Impact, Program vs S/W Product, Emergence of S/W Engineering.
3-8	**Software Life Cycle Models:** Waterfall, Prototyping, Evolutionary, Spiral models and their comparisons.
9-15	**Software Project Management:** Project Manager responsibilities, Project Planning, Project Size estimation Metrics, Project estimation Techniques, COCOMO, Staffing Level Estimation, Scheduling, Organization & Team Structures, Staffing, Risk Management.
16-22	**Requirements Analysis and Specification:** Requirement Gathering and Analysis, SRS.
23-25	**Software Design:** Overview, Cohesion and Coupling, S/W Design Approaches, Object-Oriented vs. Function-Oriented Design.
26-34	**Coding and Testing:** Coding, Code Review, Testing, Unit Testing, Black Box Testing, White-Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing, General Issues.
35-40	**Software Reliability and Quality Management:** S/W Reliability, Statistical Testing, S/W Quality, S/W Quality Management System, ISO 9000, SEI CMM, Personal Software Process, Six Sigma.
41-45	**Software Maintenance:** Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.
15 Hours	*Tutorials*

Essential Readings:

1. Software Engineering, by Sommerville, Pearson education.
2. Fundamentals of Software Engineering by Rajib Mall, PHI
3. Software Engineering by James F. Peters, Wiley
4. Software engineering A Practitioner's Approach by Pressman , MGH
5. Software Project Management From Concept to Deployment by Kieron Conway, dreamtech Press.
6. Software Engineering, by Jawadekar, TMH

RESEARCH METHODOLOGY

Course Code	CSC82DC00904	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	II	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To develop understanding of the basic framework of research process.
- To develop an understanding of various research techniques and modeling simulation techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of sampling and probability distribution.

Learning Outcomes

- To be able to understand a general definition of research and its design.
- To be able to identify the overall process of designing a research study from its inception to its report.
- To be able to formulate a research hypothesis and test the hypothesis using appropriate testing procedures.
- To be familiar with conducting a literature review and writing a report.
- Students should be able to distinguish between a population and a sample.

Pre-requisites: Basic knowledge of probability

Course Contents:

UNIT I **(15% Weightage)**

Philosophy of science, research ethics, IPR, research design, case study.

UNIT II **(20% Weightage)**

Hypothesis, Sources of Data, fundamentals of data collection methods, sampling and analysis.

UNIT III **(25% Weightage)**

Probability Distribution, Binomial, Poisson, Uniform, Exponential and Normal Distribution, Error Analysis.

UNIT IV **(20% Weightage)**

Steps of Modeling, Applications of Models, Need and Types of Simulation, Simulation Language.

UNIT V **(20% Weightage)**

Structure and components of research report, types of report, layout of research report, mechanism of writing a research report, writing a paper and self-evaluating, performing research reviews.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Philosophy of science, research ethics, IPR, research design, case study.
5-13	Hypothesis, Sources of Data, fundamentals of data collection methods, sampling and analysis.
14-28	Probability Distribution, Binomial, Poisson, Uniform, Exponential and Normal Distribution, Error Analysis..
29-35	Steps of Modelling, Applications of Models, Need and Types of Simulation, Simulation Language.
36-45	Structure and components of research report, types of report, layout of research report, mechanism of writing a research report, writing a paper and self-evaluating, performing research reviews..
15 Hours	*Tutorials*

Essential Readings:

1. R. Panneerselvam, Research Methodology, PHL Learning Private Ltd. New Delhi
2. C.R. Kothari, Research Methodology : Methods and Techniques, 2nd revised edition, New Age International (P) Limited Publishers, New Delhi.

Further Readings:

1. Anderson J., Berry H.D., Poole M., Thesis and assignment writing, Wiley Eastern Limited, New Delhi.
2. Case Study Research: Design and Methods (Applied Social Research Methods) by Robert K. Yin

ARTIFICIAL INTELLIGENCE

Course Details
Course Title: ARTIFICIAL INTELLIGENCE

Course Code	CSC91DC01004	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	III	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline based Core/Elective		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students, individual and group drills, group and individual field based assignments followed by workshops and seminar presentation.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To understand basics of AI.
- To understand how to set computational goals an achieving strategies.
- To understand computational development based on neutral system.
- To understand computational development based on Genetic Algorithm.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Understand various search methods.
- Use various knowledge representation methods.
- Understand various Game Playing techniques.
- Understand neural based computation.
- Understand genetic algorithm based computation.

Course Contents

UNIT I: Introduction to AI: (12% Weightage)

Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI.

UNIT II: Problem Solving, Search and Control Strategies : (22% Weightage)

AI Problem Solving: Problem solving as state space search, production system, control strategies and problem characteristics; Search techniques: Breadth First and Depth-first, Hill-climbing, Heuristics, Best-First Search, A* algorithm, Problem reduction and AO* algorithm, Constraints satisfaction problems,

UNIT III: Knowledge Representation, Reasoning and Game Playing (22% Weightage)

Knowledge Representation Issues, Predicate Logic, Rules : Knowledge representation, KR using predicate logic, KR using rules .

Reasoning System - Symbolic, Statistical : Reasoning , Symbolic reasoning, Statistical reasoning.

Game Playing : Overview, Mini-Max search procedure, Game playing with Mini-Max, Alpha-Beta pruning.

UNIT IV: Learning and Expert System (22%Weightage)

Learning : What is learning, Rote learning, Learning from example : Induction, Explanation Based Learning (EBL), Discovery, Clustering , Analogy, Neural net and genetic learning, Reinforcement learning.

Expert System : Introduction, Knowledge acquisition, Knowledge base, Working memory, Inference engine, Expert system shells, Explanation, Application of expert systems.

UNIT V: Neural Network, Genetic Algorithm & NLP (22% Weightage)

Fundamentals of Neural Networks : Introduction and research history, Model of artificial neuron, neural network Characteristics, Learning methods, Single-layer network system, Applications.

Fundamentals of Genetic Algorithms : Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm

Natural Language Processing : Introduction, Syntactic processing, Semantic and pragmatic analysis .

Content Interaction Plan:

Lecture cum Discussion	**Unit/Topic/Sub-Topic**

(Each session of 1 Hour)	
1-4	Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI.
5-8	AI Problem Solving: Problem solving as state space search, production system, control strategies and problem characteristics;
9-14	Search techniques: Breadth First and Depth-first, Hill-climbing, Heuristics, Best-First Search, A* algorithm, Problem reduction and AO* algorithm, Constraints satisfaction problems,
15-17	Knowledge Representation Issues, Predicate Logic, Rules : Knowledge representation, KR using predicate logic, KR using rules .
18-20	Reasoning System - Symbolic, Statistical: Reasoning , Symbolic reasoning, Statistical reasoning.
21-24	Game Playing : Overview, Mini-Max search procedure, Game playing with Mini-Max, Alpha-Beta pruning
25-30	**Learning :** What is learning, Rote learning, Learning from example : Induction, Explanation Based Learning (EBL), Discovery, Clustering , Analogy, Neural net and genetic learning, Reinforcement learning.
31-34	**Expert System :** Introduction, Knowledge acquisition, Knowledge base, Working memory, Inference engine, Expert system shells, Explanation, Application of expert systems.
35-39	**Fundamentals of Neural Networks :** Introduction and research history, Model of artificial neuron, neural network Characteristics, Learning methods, Single-layer network system, Applications..
40-42	**Fundamentals of Genetic Algorithms :** Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm
43-45	**Natural Language Processing :** Introduction, Syntactic processing, Semantic and pragmatic analysis
15 Hours	*Tutorials*

Essential Readings:

- E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill.
- S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
- N.J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann.
- Introduction to Artificial Intelligence by Philip C Jackson

Additional/Advance/Further Readings:

- "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, (2002), Prentice Hall, Chapter 1-27, page 1-1057.
- "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", by George F. Luger, (2002), Addison-Wesley, Chapter 1- 16, page 1-743.
- "AI: A New Synthesis", by Nils J. Nilsson, (1998), Morgan Kaufmann Inc., Chapter 1-25, Page 1-493.
- "Artificial Intelligence: Theory and Practice", by Thomas Dean, (1994), Addison Wesley, Chapter 1-10, Page 1-650.
- "Neural Network, Fuzzy Logic, and Genetic Algorithms - Synthesis and Applications", by S. Rajasekaran and G.A. VijayalaksmiPai, (2005), Prentice Hall, Chapter 1-15, page 1-435.
- "Computational Intelligence: A Logical Approach", by David Poole, Alan Mackworth, and Randy Goebel, (1998), Oxford University Press, Chapter 1-12, page 1-608.

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	CSC91DC01104	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	III	**Contact Hours**	45 (L) + 30 (P) Hours
Course Type	Discipline Based Core Course		
Nature of the Course	Theory/Practical		

Special Nature/ Category of the Course (*if applicable*)	Skill Based
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students, individual and group drills, group and individual field based assignments followed by workshops and seminar presentation.
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)

Course Objectives

- Ability to analyze a problem and design the appropriate algorithm for the problem.
- This course aims to introduce the classic algorithms in various domains
- The course aims to introduce the techniques for designing efficient algorithms.
- Comparing different algorithms based on efficiency and performance.
- Introduction to some Non Polynomial time solvable computational problems.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Design algorithms for classical computational problems.
- Compare two different algorithms based on efficiency.
- Choose correct algorithm based on case.
- Differentiate between polynomial and non-polynomial time solvable computational problems.
- Identify the open challenges in computer algorithms.

Course Contents

UNIT I: Introduction and basic concepts (25% Weightage)

Complexity measures, worst-case and average-case complexity functions, problem complexity, quick review of common algorithm design principles.

UNIT II: Searching, Sorting and Hashing (25% Weightage)

Sorting and selection: Finding maximum and minimum, k largest elements in order; Sorting by selection, heap sort methods, lower bound for sorting, other sorting algorithms - quick sort, merge sort.

Searching and set manipulation: Searching in static table - binary search, path lengths in binary trees, and applications, Huffman tree, binary search trees, AVL and (a, b) trees.

Hashing: Basic ingredients, analysis of hashing with chaining and with open addressing,

UNIT III: Graph problems (25% Weightage)

Graph searching - BFS, DFS, shortest first search, topological sort; connected and biconnected components; minimum spanning trees - Kruskal's and Prim's algorithms, Single-Source Shortest Path, All-Pairs Shortest Paths. Backtracking: n-Queens Problem.

UNIT IV: Introduction to NP-completeness (25% Weightage)

Informal concepts of deterministic and nondeterministic algorithms, P and NP, NP-completeness, statement of Cook's theorem, some standard NP-complete problems.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Complexity measures, worst-case and average-case complexity functions, problem complexity,
5-7	quick review of common algorithm design principles.
8-12	**Sorting and selection:** Finding maximum and minimum, k largest elements in order; Sorting by selection, heap sort methods, lower bound for sorting.
13-17	Other sorting algorithms - quick sort, merge sort
18-22	**Searching and set manipulation:** Searching in static table – binary search, path lengths in binary trees, and applications
23-27	Huffman tree, binary search trees, AVL and (a, b) trees.

28-31	**Hashing:** Basic ingredients, analysis of hashing with chaining and with open addressing,
32-35	Graph searching - BFS, DFS, shortest first search, topological sort; connected and biconnected components;
36-40	Minimum spanning trees - Kruskal's and Prim's algorithms, Single-Source Shortest Path, All-Pairs Shortest Paths. Backtracking: n-Queens Problem.
41-45	Informal concepts of deterministic and nondeterministic algorithms, P and NP, NP-completeness, statement of Cook's theorem, some standard NP-complete problems.
15 Hours	*Tutorials*

Essential Readings:

1. T. H. Cormen, C.E. Leiserson and R.L.Rivest: Introduction to Algorithms, Prentice Hall of India, New Delhi, 1998.
2. E. Horowitz and S. Sahni: Fundamental of Computer Algorithms, Galgotia Pub./Pitman,New Delhi/London, 1987/1978.

Suggested Readings:

1. Aho, J. Hopcroft and J. Ullman; The Design and Analysis of Computer Algorithms, A.W.L, International Student Edition, Singapore, 1998.
2. S. Baase: Computer Algorithms: Introduction to Design and Analysis, 2nd ed., Addison-Wesley, California, 1988.
3. K. Mehlhorn: Data Structures and Algorithms, Vol. 1 and Vol. 2, Springer-Verlag, Berlin, 1984.
4. Borodin and I. Munro: The Computational Complexity of Algebraic and Numeric Problems, American Elsevier, New York, 1975.

Project in Industry/Academia

Course Code	CSC91DC01220	**Credits**	20
Semester	IV	**Course Duration**	One Semester

Course Type	Discipline Based Core
Nature of the Course	Project/Industrial Training/Internship
Methods of Content Interaction	Seminar, primary data collection & analysis, presentations by students, field work etc.
Assessment and Evaluation	• 30% - Internal Assessment (Formative in nature but also contributing to the final grades) • 70% -End Term External Examination (University Examination)

Elective Basket (Within Dept.)

COMPUTER ORGANIZATION

Course Code	CSC82DE01304	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, assignments.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To have the understanding of computer organization: structure and operation of computers and their peripherals.
- Understanding the concepts of programs as machine instruction sequences.
- Exposure to the ways of communicating with I/O devices and standard I/O interfaces.

- Describe memory hierarchy.
- Describe arithmetic and logical operations.
- To have the knowledge of basic processing unit and organization of simple processor, pipelining technique and other large computing systems.

Course Learning Outcomes

After going through this course a student should be able to:

- Design simple circuits and buses.
- Describe the organization of computer
- Describe various components of Computer especially personal computer.
- Describe the mechanism of working of the computer (including interrupts)
- Describe the instruction format/ set of a computer

Prerequisites: Number systems, Boolean algebra, Boolean expressions, Karnaugh Maps, Basic logic gates, logic diagrams. Combinational circuits, Sequential circuits.

Course Contents

UNIT I **[3% Weightage]**

Introduction: Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer.

UNIT II **[15% Weightage]**

Representation of Instructions: Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures.

UNIT III **[20% Weightage]**

Processing Unit: Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Microprogrammed control unit.

UNIT IV **[20% Weightage]**

Memory Subsystem: Basic concepts semiconductor RAM memories. Read-only memories, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Address translation, Hardware support for memory management.

UNIT V **[20% Weightage]**

Input/Output Subsystem: Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input –Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus.

UNIT VI **[22% Weightage]**

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

Tutorial: 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	**Introduction**: Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer.
3-8	**Representation of Instructions**: Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures.
9-14	**Processing Unit**: Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Microprogrammed control unit.

15-21	**Memory Subsystem**: Basic concepts semiconductor RAM memories. Read-only memories, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms.
22-26	Memory management unit - Concept of virtual memory, Address translation, Hardware support for memory management.
27-32	**Input/Output Subsystem**: Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer.
33-37	Priority Interrupt Direct memory Access, Input – Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus.
38-42	**Pipeline and Vector Processing** : Parallel Processing, Pipelining, Arithmetic Pipeline.
43-45	Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.
15 Hours	*Tutorials*

Essential Readings:

1. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw-Hill, 2002.
2. M. Morris Mano, “Computer System architecture”.

Further Readings:

1. W.Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India, 2002.
2. D.A.Patterson and J.L.Hennessy, "Computer Organization and Design – The
3. Hardware/Software Interface", Morgan Kaufmann, 1998
4. J .P.Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.

DISTRIBUTED SYSTEMS

Course Code	CSC82DE01404	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture, Tutorials, seminar, presentations by students.*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives :

- To learn and analyze how a set of connected computers can form a functional, usable and high-performance distributed systems.
- To learn the principles, architectures, algorithms and programming models used in distributed systems.
- To examine state-of-the-art distributed File systems.
- To design and implement sample distributed systems.

Course Learning Outcomes :

- Students will identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
- Students will examine how existing systems have applied the concepts of distributed systems in designing large systems, and will additionally apply these concepts to develop sample systems.

- Students will learn the core concepts underlying distributed systems designs. They will understand the system constraints, trade-offs and techniques in distributed systems to best serve the computing needs for different types of data and applications.

Prerequisites: **Fundamental of Operating System**

Course Contents:

UNIT I

Fundamentals: Definition, Evolution of distributed Computing System Distributed Computing System Models, Distributed Operating System, Designing a distributed Operating System, Introduction of distributed computing environment.

(12 % Weightage)

UNIT II

Message Passing: Introduction, Desirable features, Issues in IPC by message passing, synchronization, Buffering, Multi datagram messages, encoding and decoding message data.

(18 % Weightage)

UNIT III

Clock Synchronization and Mutual Exclusion : Introduction, Clock synchronization, Mutual exclusion in Distributed systems, Deadlocks, Deadlocks in Distributed systems.

(20 % Weightage)

UNIT IV

Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC mechanism RPC messages server management, parameter-passing and call semantic, Communication protocols for RPC's.

(10 % Weightage)

UNIT V

Distributed Shared Memory: Introduction, Architecture of DSM Systems Design and implementation, granularly, structure of shared memory space Consistency models, replacement strategy, Thrashing.

(10 % Weightage)

UNIT VI

Resource Management: Desirable feature, Task assignment approach, Load-balancing approach, Load-sharing approach.

(12 % Weightage)

UNIT VII

Process Management: Introduction, Process Migration, Threads.

(08 % Weightage)

UNIT VIII

Distributed File Systems: Intakes, Desirable features, File models, File accessing models, file-sharing semantic, File- caching schemes, File replication Fault tolerance, Automatic Transactions, Design principle.

(10 % Weightage)

Content Interaction Plan

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	**Fundamentals:** Definition, Evolution of distributed Computing System Distributed Computing System Models, Distributed Operating System,
3-6	Designing a distributed Operating System, Introduction of distributed computing environment.
7 -12	**Message Passing:** Introduction, Desirable features, Issues in IPC by message passing, synchronization, Buffering, Multi datagram messages, encoding and decoding message data.

13-14	**Clock Synchronization and Mutual Exclusion :** Introduction, Clock synchronization, Mutual exclusion in Distributed systems
15-18	Deadlocks, Deadlocks in Distributed systems
19-20	**Remote Procedure Calls:** Introduction, The RPC Model, Transparency of RPC
21-23	Implementing RPC mechanism, RPC messages server management, parameter-passing and call semantic, Communication protocols for RPC's.
24-29	**Distributed Shared Memory:** Introduction, Architecture of DSM Systems Design and implementation, granularly, structure of shared memory space Consistency models, replacement strategy, Thrashing.
30-34	**Resource Management:** Desirable feature, Task assignment approach, Load-balancing approach, Load-sharing approach.
35-39	**Process Management:** Introduction, Process Migration, Threads.
40-45	**Distributed File Systems:** Intakes, Desirable features, File models, File accessing models, file-sharing semantic, File- caching schemes, File replication Fault tolerance, Automatic Transactions, Design principle.
15 Hours	***Tutorials***

Essential Readings:

1. Distributed Operating Systems Concepts and Design – P.K. Sinha (PHI)
2. Distributed Systems concepts and Design – G. Coulouris, J. Dollimore & T. Kindberg
3. Distributed Systems Concepts & Design by George Coulouris, Jean Dollimore & Tim Kindberg
4. Modern Operating Systems – A. S. Tanenbaum (PHI)
5. Modern Operating Systems – Singhal

COMPUTER GRAPHICS

Course Details			
Course Title: COMPUTER GRAPHICS			
Course Code	CSC82DE01504	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester

Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline based Elective		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, seminar, presentations by students, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To learn the basic principles and components of a computer graphics system.
- Provide an understanding of raster scanning techniques for basic geometrical primitives.
- Provide an understanding of two and three dimensional geometric transformations for images/pictures.
- To be able to discuss the application of computer graphics concepts in some of the real applications.

Course Learning Outcomes

- To provide comprehensive introduction about computer graphics system, design algorithms and two dimensional transformations.
- To make the students familiar with techniques of clipping, three dimensional graphics and three dimensional transformations.
- To make the student familiar with multimedia and its applications.

Pre-requisites: Computer Organization

Course Contents:

UNIT I

The origin of computer graphics, Interactive graphics display, new display devices, Points and Lines, DDA, Bresenham's Algorithms, Circles and Ellipse drawing algorithms

UNIT II

Two Dimensional Geometric Transformations: Basic Transformations – Matrix Representations - Composite Transformations. Two Dimensional Viewing: Line Clipping – Polygon Clipping – Curve Clipping – Text Clipping.

UNIT III

Three-Dimensional Concepts - Three Dimensional object Representations - Fractal Geometry Methods – Three Dimensional Geometric and Modeling Transformations: Translation – Rotation – Scaling. Three Dimensional Viewing: Viewing Pipeline – Viewing Coordinates – Projections – Clipping.

UNIT IV

Visible–Surface Detection Methods, Classification of Visible Surface Detection Algorithms – Back Face Detection - Depth-Buffer Method - A-Buffer Method.Color Models and Color Applications: RGB – YIQ – CMY – HSV.

UNIT V

Introduction to multimedia, multimedia applications, multimedia hardware, multimedia tools, lossless and lossy compression, Huffman coding.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**

1-10	The origin of computer graphics, Interactive graphics display, new display devices, Points and Lines, DDA, Bresenham's Algorithms, Circles and Ellipse drawing algorithms.
11-23	Two Dimensional Geometric Transformations: Basic Transformations – Matrix Representations - Composite Transformations. Two Dimensional Viewing: Line Clipping – Polygon Clipping – Curve Clipping – Text Clipping.
24-34	Three-Dimensional Concepts - Three Dimensional object Representations - Fractal Geometry Methods – Three Dimensional Geometric and Modeling Transformations: Translation – Rotation – Scaling. Three Dimensional Viewing: Viewing Pipeline – Viewing Coordinates – Projections – Clipping.
35-40	Visible–Surface Detection Methods, Classification of Visible Surface Detection Algorithms – Back Face Detection - Depth-Buffer Method - A-Buffer Method.Color Models and Color Applications: RGB – YIQ – CMY – HSV.
41-45	Introduction to multimedia, multimedia applications, multimedia hardware, multimedia tools, lossless and lossy compression, Huffman coding.
15 Hours	*Tutorials*
	Essential Readings: 1. Donald Hearn and M. Pauline Baker, 'Computer Graphics C Version', Prentice – Hall of India, Second Edition. 2. Hill, Francis S., Computer Graphics Using OpenGL, Prentice-Hall, 2001. 3. Prabhat K Andleighand KiranThakrar, "Multimedia Systems and Design", PHI, 2003.

	4. Tay Vaughan " Multimedia: making it work" Tata McGraw Hill 1999, 4th Edition **Further Readings:** 1. Steven Harrington, "Computer Graphics – A Programming Approach", McGraw Hill, second edition. 2. Multimedia Computing, Communication & Applications, Ralf Steinmetz and KlaraNashtedt. Prentice Hall.1995(TB2) 3. OpenGL programming guide by Woo, Neider, Davis &Shreiner, 3rd Edition 2000, Pearson Education Asia. 4. Judith Jeffcoate, "Multimedia in practice technology and Applications", PHI,1998. 5. D.D. Hearn, M.P. Baker, Computer Graphics with OpenGL, 3/e, pearson

INTERNET TECHNOLOGY

Course Details			
Course Title: INTERNET TECHNOLOGY			
Course Code:	CSC82DE01604	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory/Skill Based
Methods of Content Interaction	Lecture, Assignments, Class Tests, Student Presentations, mini projects.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students about basics of common Internet Technologies that are dominant in Internet domain such as TCP/IP and its basics and various web development technologies
- To introduce students about basics of e-commerce and how its security requirements are met.
- To introduce students about how emerging trends that have gained popularity recently in the Internet worlds.

Course Learning outcomes

After the course the students will be able to:

- understand basics of how Internet and its applications works
- understand the basics of the technologies that are used to develop variety of contents available on the Internet.
- understand about the security issues and challenges associated with e-commerce.
- know about recent trends in the domain of Internet Technologies
- gain insight to the some of the dominant technologies in the Internet domain.

Course Contents:

UNIT I: (25% Weightage)

Introduction to Internet, TCP/IP: addressing and routing. Internet applications: FTP, Telnet, Email, Chat.

UNIT II: (25% Weightage)

World Wide Web: HTTP protocol. Designing web pages: HTML, forms, CGI scripts, JavaScript, PHP, DHTML, XML

UNIT III: **(25% Weightage)**

E-Commerce and security issues including symmetric and asymmetric key, encryption and digital signature, authentication, confidentiality, hash functions and message integrity

UNIT IV: **(25% Weightage)**

Emerging trends in Internet Technologies, Internet telephony, Introduction to virtual reality over the web, etc. Intranet and extranet, firewall and their types.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-1	Introduction to Internet
2-5	TCP/IP: addressing and routing
6-12	Internet applications: FTP, Telnet, Email, Chat.
13-14	World Wide Web
15-17	HTTP protocol
18-22	Designing web pages: HTML, forms, CGI scripts
23-26	JavaScript
27-31	PHP
32-32	DHTML
33-33	XML
34-35	E-Commerce and security issues including symmetric and asymmetric key
36-37	encryption and digital signature, confidentiality
38-39	Authentication, hash functions and message integrity
40-40	Emerging trends in Internet Technologies
41-42	Internet telephony
43-43	Introduction to virtual reality over the web
44-44	Intranet and extranet
45-45	firewall design issues
15 Hours	Tutorials

Essential Readings:

1. Burdman, “Collaborative Web Development” Addison Wesley.

2. Chris Bates, "Web Programing Building Internet Applications", 2nd Edition, WILEY, Dreamtech
3. Joel Sklar, "Principal of web Design" Vikash and Thomas Learning
4. W. Stallings, Cryptography and Network Security: Principles and Practice, 2nd Edition, Prentice Hall, 1998

Suggested Readings:

1. W3School.com
2. Hans Bergsten, "Java Server Pages", SPD O'Reilly

MOBILE NETWORK SYSTEMS

Course Details			
Course Title: MOBILE NETWORK SYSTEMS			
Course Code:	CSC82DE01704	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory
Methods of Content Interaction	Lecture, Assignments, Tutorials, Class Tests, Student Presentations		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students about basics of mobile networks and their management functions
- To introduce students about various wireless networks technology like IEEE 802.11, Bluetooth and the protocols employed by them.
- To introduce students about how mobile networks handle user data and services
- To introduce students about how mobile networks offer transaction process and security to their users
- To introduce students about Adhoc Networks, the routing algorithms used by them.

Course Learning outcomes

After the course the students will be able to:

- understand how mobile networks offer their user services
- understand the protocols used in mobile network
- understand design issues and challenges unique mobile networks and how they affects underlying protocols and services

Course Contents:

UNIT I (25%Weightage)

Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.

UNIT II (25% Weightage)

Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Bluetooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.

UNIT III (10% Weightage)

Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations.

UNIT IV (10% Weightage)

Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

UNIT V (30% Weightage)

Adhoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Introduction, issues in mobile computing
3-5	Overview of wireless telephony, cellular concept
6-9	GSM: air-interface, channel structure, location management, HLR-VLR
10-11	hierarchical, handoffs, channel allocation in cellular systems
12-14	CDMA, GPRS
15-16	Wireless Networking, Wireless LAN Overview: MAC issues, Wireless applications, data broadcasting
17-20	IEEE 802.11, Bluetooth
21-22	TCP over wireless
23-24	Mobile IP
25-28	WAP: Architecture, protocol stack, application environment, applications
30-31	Data management issues, data replication for mobile computers
32-32	adaptive clustering for mobile wireless networks, File system
33-33	Disconnected operations
34-35	Mobile Agents computing, security and fault tolerance
36-36	transaction processing in mobile computing environment
37-39	Adhoc networks, localization, MAC issues
40-41	Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV)
42-44	Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA)
45-45	QoS in Ad Hoc Networks, applications
15 Hours	Tutorials

Essential Readings:

1. J. Schiller, Mobile Communications, Addison Wesley.
2. Charles Perkins, Mobile IP, Addison Wesley.

Suggested Readings:

1. Upadhyaya, “Mobile Computing”, Springer.

2. Charles Perkins, Ad hoc Networks, Addison Wesley.

WIRELESS SENSOR NETWORKS

Course Details			
Course Title: WIRELESS SENSOR NETWORKS			
Course Code:	CSC82DE01804	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory
Methods of Content Interaction	Lecture, Assignments, Class Tests, Student Presentations		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students about basics wireless sensor networks, their applications
- To introduce students about hardware and software architecture of WSN and associated design challenges
- To introduce students about deployment and management of sensor nodes in a WSN
- To introduce students about how sensor nodes gather, process, aggregates and transmit the data.
- To introduce students about security issues and challenges unique to sensor networks.

Course Learning outcomes

After the course the students will be able to:

- understand the architecture, applications and design challenges unique to WSN
- understand the data gathering, processing, aggregation and routing mechanisms used by WSN
- understand software and hardware related design challenges associated with WSN

Course Contents:

UNIT 1 **(25% Weightage)**

Introduction to wireless sensor networks (WSNs) and their applications, Sensor definition, Examples of available sensor nodes, Design challenges, Performance metrics, Contemporary network architectures, Operational and computational models, Software and hardware setups

UNIT 2 **(20% Weightage)**

Network Bootstrapping: Sensor deployment mechanisms, Issues of coverage, Node discovery protocols, Localization schemes, Network clustering

UNIT 3 **(25% Weightage)**

Data dissemination and routing: Query models, In-network data aggregation, Robust route setup, Coping with energy constraints.

UNIT 4 **(30% Weightage)**

Physical and Link layers: Radio energy consumption model, Power management, medium access, arbitration, Optimization mechanisms.

Dependability Issues: Security challenges, Threat and attack models, Quality of service provisioning, Clock synchronization, Supporting fault tolerant operation.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Introduction to wireless sensor networks (WSNs) and their applications
3-3	Sensor definition, Examples of available sensor nodes
4-5	Design challenges, Performance metrics
6-7	Contemporary network architectures
8-10	Operational and computational models,
11-12	Software and hardware setups
13-13	Sensor deployment mechanisms
14-15	Issues of coverage
16-18	Node discovery protocols
19-21	Localization schemes

22-24	Network clustering
25-26	Query models
27-29	In-network data aggregation
30-33	Robust route setup
34-34	Coping with energy constraints
35-38	Radio energy consumption model, Power management
39-42	Medium access, arbitration, Optimization mechanisms
43-43	Security challenges, Threat and attack models
44-44	Clock synchronization
45-45	Supporting fault tolerant operation
15 Hours	Tutorials

Essential Readings:

1. Azzedine Boukerche, Handbook of Algorithms for Wireless Networking and Mobile Computing, Chapman & Hall/CRC, 2006**.**
2. Protocols and Architectures for Wireless Sensor Networks Holger Karl, Andreas Willig, Wiley, ISBN:0-470-09510-5, June 2005

Suggested Readings:

1. Mohammad Ilyas and Imad Mahgoub, Handbook of Sensor Networks: Compact Wireless and Wired sensing systems, CRC Press, 2005.
2. Wireless Sensor Networks Cauligi S. Raghavendra, Krishna Sivalingam, Taieb M. Znati, Springer, ISBN:1-4020-7883-8, August 2005.
3. Jr., Edgar H. Callaway, Wireless Sensor Networks: Architecture and Protocols, Auerbach, 2003.
4. Anna Hac, Wireless Sensor Networks Designs, John Wiley & Sons Ltd., 2003.
5. Nirupama Bulusu and Sanjay Jha, Wireless Sensor Networks: A systems perspective, Artech House, August 2005.

NEXT GENERATION NETWORKS

Course Details			
Course Title: NEXT GENERATION NETWORKS			
Course Code:	CSC82DE01904	**Credits**	4

L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory/Skill Based
Methods of Content Interaction	Lecture, Assignments, Class Tests, Student Presentations		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students with next generation networks their evolution
- To provide students' knowledge about next generation networks technologies, their advantages, disadvantages and the services they offer
- To introduce students about their design respective issues and challenges

Course Learning outcomes

After the course the students will be able to:

- Know about the next generation networks emerging around them how they are going to change the way of communication.
- understand the architecture, applications and design challenges associated with the next generation
- understand the mechanism used by these networks for connection setup, channel access, routing and so on.

Course Contents:

UNIT 1 **(25% Weightage)**

Introduction to Next Generation Wireless Networks (NGNs), their evolution, Architecture of NGNs and QoS.

UNIT 2 **(40% Weightage)**

UMTS: the radio access network (UMTS Terrestrial Radio Access Network, or UTRAN), the core network (Mobile Application Part, or MAP) and the authentication of users via SIM

(subscriber identity module) cards. Introduction to Mobile Ad-hoc Networks (MANETs) Security and Routing in MANETs.

UNIT 3 **(25% Weightage)**

Wi-Fi Networks, and Cellular Wireless Network Introduction to WiMAX Networks.

UNIT 4 **(10% Weightage)**

Introduction to Dynamic Spectrum Allocation and Dynamic Spectrum Access Networks.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-3	Introduction to Next Generation Wireless Networks, their evolution
4-9	Architecture of NGNs and QoS
6-7	UMTS: the radio access network
8-10	the core network (Mobile Application Part, or MAP)
11-12	authentication of users via SIM (subscriber identity module) cards
13-14	Introduction to Mobile Ad-hoc Networks (MANETs)
14-16	MANETs Security
17-22	Routing in MANETs
23-28	Wi-Fi Networks
29-34	Cellular Wireless Network
35-39	Introduction to WiMAX Networks
40-42	Introduction to Dynamic Spectrum Allocation
43-45	Dynamic Spectrum Access Networks.
15 Hours	Tutorials

Essential Readings:

1. Convergence Technologies for 3G Networks: IP, UMTS, EGPRS and ATM Authors: Jeffrey Bannister, Paul Mather, and Sebastian Coope, . John Wiley & Sons.

2. Next Generation Networks Services: Technologies and Strategies, by Neill Wilkinson, ISBN:9780471486671, John Wiley & Sons, Ltd
3. Mobile Communication, by Jochen Schiller, ISBN - 9788131724262 Pearson Education

Suggested Readings:

1. CDMA2000 Evolution: System Concepts and Design Principles Author: Kamran Etemad, Wiley-Inter science.
2. Next-Generation Network Services, by Robert Wood, ISBN-10: 1587051591 ISBN-13: 978-1587051593, Cisco Press
3. Next Generation Intelligent Networks, by Johan Zuidweg, ISBN: 9781580532631 Artech House

DIGITAL LOGIC AND DESIGN

Course Details			
Course Title: DIGITAL LOGIC AND DESIGN			
Course Code	CSC82DE02004	Credits	4
L + T + P	3 + 1 + 0	Course Duration	One Semester
Semester		Contact Hours	45 (L) + 15 (T) Hours
Course Type	Discipline based Elective		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To study the basic concept of underlying the various number systems, negative number representation, binary number systems.
- Arithmetic, binary codes and error detecting and correcting binary codes.
- To study the theory of Boolean algebra.
- To learn the representation of switching functions using Boolean algebra.
- Expressions and their minimization techniques.
- To study the combinational logic design of various logic and switching devices and their realization.
- To study the sequential logic circuits design - both in synchronous and Asynchronous modes.
- Logic and switching devices, their minimization techniques and their realizations.

Course Learning Outcomes:

The student will be able to:

- Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.
- Understand the different switching algebra theorems and apply them for logic functions.
- Design the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions.
- Explain the following combinational circuits: buses, encoders/decoders, (de)multiplexers, exclusive-ORs, comparators, arithmetic-logic units.
- Understand different latches and flip-flops.
- Derive the state-machine analysis or synthesis.
- Understand sequential circuits, like counters and shift registers.

Course Contents:

UNIT : I **[20% Weightage]**

Digital Systems and Binary Numbers: Digital Systems – Number systems and base conversions – Representation of signed Binary Numbers – Binary codes – Logic gates.

UNIT : II **[30% Weightage]**

Boolean Algebra : Introduction to Boolean Algebra – Axioms and Laws of Boolean Algebra – Boolean functions – Canonical and Standard Forms. Gate – Level Minimization : Introduction – Two, Three, Four Variable K-map's – Don't Care Conditions – NAND and NOR implementation.

UNIT : III **[20% Weightage]**

Combinational Logic : Introduction to combinational logic circuits – Binary adder and subtractor – Look Ahead Carry Adder - Magnitude comparator – Decoders – Encoders – Multiplexers – Demultiplexers.

UNIT : IV **[5% Weightage]**

Memory and Programmable Logic : Introduction to Programmable Logic Devices(PLD's) – Programmable ROM(PROM) – Programmable Logic Array(PLA) – Programmable Array Logic(PAL).

UNIT : V **[25% Weightage]**

Synchronous Sequential Logic : Introduction to sequential circuits – Latch – Flip Flop – SR, JK, T, D Flip Flops – Flip Flop excitation tables. Registers and Counters : Registers – Shift registers – Ripple counters –Synchronous counters – Other counters.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Digital Systems and Binary Numbers: Digital Systems
2-6	Number systems and base conversions

6-8	Representation of signed Binary Numbers – Binary codes – Logic gates.
9-11	Boolean Algebra : Introduction to Boolean Algebra – Axioms and Laws of Boolean Algebra
12-13	Boolean functions – Canonical and Standard Forms
14-17	Gate – Level Minimization
18-22	Introduction – Two, Three, Four Variable K-map's – Don't Care Conditions – NAND and NOR implementation.
23-25	Combinational Logic : Introduction to combinational logic circuits – Binary adder and subtractor
26-27	Look Ahead Carry Adder - Magnitude comparator
28-30	Decoders – Encoders
31-34	Multiplexers – Demultiplexers
35-36	Memory and Programmable Logic : Introduction to Programmable Logic Devices(PLD's) – Programmable ROM(PROM) – Programmable Logic Array(PLA) – Programmable Array Logic(PAL).
37-41	Synchronous Sequential Logic : Introduction to sequential circuits – Latch – Flip Flop – SR, JK, T, D Flip Flops – Flip Flop excitation tables.
42-45	Registers and Counters : Registers – Shift registers – Ripple counters – Synchronous counters – Other counters.
15 Hours	*Tutorials*

Essential Readings:

1. Digital Logic and Computer Design by M. Moris Mano, 4th Edition.

2. Digital Principles and Applications by Leach, Paul Malvino, 5th Edition.

Further Readings:

1. Fundamentals of Digital Logic Design by Charles H.Roth, Jr. 5th Edition,

Cengage

2. Digital Electronics by G.K. Kharate, Oxford University Press

3. Switching Theory and Logic Design by A. Anand Kumar, PHI, 2nd Edition.

MODELING AND SIMULATION

Course Code	CSC82DE02104	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, presentations by students, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- The purpose of this course is to develop a model corresponding to a real system and perform simulation using model.
- Random number generation techniques will be described to perform various activities of simulations.
- Prepare to learn one of the simulation languages to implement the conceptual model.

Course Learning Outcomes

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

- Describe difference between model and system.
- Know the steps for developing the simulation model
- Generate random numbers and also test them for uniformity and independence properties.
- Derive various performance parameters for Queuing systems using both analytic and simulation approaches.
- Write a program using simulation language for a given problem

Prerequisites: Students should have knowledge of probability distribution and computer programming.

Course Contents:

UNIT I **(15% weightage)**

Fundamental of Modeling and Simulation: Introduction to Simulation, Merits and demerits of simulation, Areas of application, Types of systems, various types of models to represent them, Discrete and Continuous systems. Stages of a typical simulation study, Simulation Examples, Concepts of system Clocks, Event scheduling Vs Time advance algorithms.

UNIT II **(15% weightage)**

Simulation Models: Continuous Simulation, Monte-Carlo Simulation, Discrete-event simulation, Numerical computation techniques, Lag models, distributed lag model and cobweb model.

Verification and Validation of Models: Simulation Process, Guidelines for verification of models, their calibration and Validation, Face validity, Validation of model assumptions, Validating input –output transformations, Use of historical Data.

UNIT III **(25% weightage)**

Random Numbers: Roles of random numbers in simulation, pseudo random number generation techniques, properties, methods of testing PRN sequences. Random variate: Generation, Inverse transformation techniques- with exponential distributions and empirical continuous distributions, Direct transformations with Normal distributions, Acceptance

Rejection techniques, with Poisson distribution, Goodness of fit tests, Chi square test, Kolmogorov- Smirnov test

UNIT IV **(25% weightage)**

Queuing Networks: Analytical and simulation modeling of queuing system**,** M/M/1, M/M/∞, M/M/n**,** Performance evaluation.

UNIT V **(20% weightage)**

Simulation Languages: Needs of special purpose simulation Languages, Detailed study of one simulation language.

Evaluation of Simulation Experiments: sample generation, application in industry and service organization, static and dynamic stochastic simulations, elimination of transients, variance reduction techniques.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-8	**Fundamental of Modeling and Simulation:** Introduction to Simulation, Merits and demerits of simulation, Areas of application, Types of systems, various types of models to represent them, Discrete and Continuous systems. Stages of a typical simulation study, Simulation Examples, Concepts of system Clocks, Event scheduling Vs Time advance algorithms.
9-12	**Simulation Models:** Continuous Simulation, Monte-Carlo Simulation, Discrete-event simulation, Numerical computation techniques, Lag models, distributed lag model and cobweb model.
13-15	**Verification and Validation of Models:** Simulation Process, Guidelines for verification of models, their calibration and Validation, Face validity, Validation of model assumptions, Validating input –output transformations, Use of historical Data.

16-18	**Random Numbers:** Roles of random numbers in simulation, pseudo random number generation techniques, properties, methods of testing PRN sequences.
19-27	Random variates: Generation, Inverse transformation techniques- with exponential distributions and empirical continuous distributions, Direct transformations with Normal distributions, Acceptance Rejection techniques, with Poisson distribution, Goodness of fit tests, Chi square test, Kolmogorov- Smirnov test
28-38	**Queuing Networks:** Analytical and simulation modeling of queuing system**,** M/M/1 , M/M/∞, M/M/n**,** Performance evaluation.
39-45	**Simulation Languages:** Needs of special purpose simulation Languages, Detailed study of one simulation language. **Evaluation of Simulation Experiments:** sample generation, application in industry and service organization, static and dynamic stochastic simulations, elimination of transients, variance reduction techniques.
15 Hours	*Tutorials*

Essential Readings:

1. System simulation, by G. Gordon, 2nd edition, 2011, Prentice Hall
2. Simulation Modeling and Analysis, A M Law, fourth edition, 2008, TMH

Further Readings:

1. Jerry Banks, John S. Carson & Barry L. Nelson – Discrete Event system simulation PHI
2. Simulation and the Monte Carlo Method, Reuven Y Rubinstein- 1981, (John Wiley& Sons).
3. Computer Networks and Systems: Queueing Theory and Performance Evaluation , Thomas G. Robertazzi - 2000, (Springer).

STATISTICAL METHODS

Course Code	CSC82DE02204	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		

Nature of the Course	Theory
Methods of Content Interaction	Lecture, Tutorials, self-study, assignments.
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)

Course Objectives

- To be familiar with basic concept of event and probability.
- To introduce random variable and various probability distribution.
- Understand the sampling and sampling Distribution.
- Infer the sample statistics from population.

Course Learning Outcomes

After going through this course a student should be able to:

- Apply statistical methods to get sample characteristics from population.
- Formulate sample statistics in the form of hypothesis .
- Test the hypothesis using appropriate technique .

Course Contents:

UNIT I **(20% weightage)**

Introduction to Probability; Experiments, Events and their Probabilities; Some basic Relationships of Probability, Conditional Probability, Baye's Theorem.

UNIT II **(25% weightage)**

Random Variables: Discrete, Continuous; Discrete Probability Distributions; Expected Value & Variance; Binomial Probability Distribution, Poisson Probability Distribution, Normal Probability Distribution, Normal Approximation of Binomial Probabilities, Exponential Probability Distribution.

UNIT III **(25% weightage)**

Sampling and Sampling Distribution: Sampling methods, Introduction to Sampling Distributions, Sampling Distribution of mean, Sampling Distribution of Variance, Determining the Sample Size; Population Proportion.

UNIT IV **(30% weightage)**

Statistical Inference-Testing of Hypothesis: Test of significance for Large Samples: Difference between Small & Large Samples; Two-tailed test for Difference between the Means of Two Samples; Students' t-Distribution; Properties & Applications of t-Distribution; Testing Difference between Means of Two Samples (Independent Samples; Dependent Samples), Definition of chi-square; Degrees of freedom; chi-square Distribution; Chi-square Test; F-Test. ANOVA.

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Introduction to Probability; Experiments, Events and their Probabilities; Some basic Relationships of Probability, Conditional Probability, Baye's Theorem.
4-15	Random Variables: Discrete, Continuous; Discrete Probability Distributions; Expected Value & Variance; Binomial Probability Distribution, Poisson Probability Distribution, Normal Probability Distribution, Normal Approximation of Binomial Probabilities, Exponential Probability Distribution
15-22	Sampling and Sampling Distribution: Sampling methods, Introduction to Sampling Distributions, Sampling Distribution of mean, Sampling Distribution of Variance, Determining the Sample Size; Population Proportion.
22-35	Statistical Inference-Testing of Hypothesis: Test of significance for Large Samples: Difference between Small & Large Samples; Two-tailed test for Difference between the Means of Two Samples; Students' t-Distribution;

	Properties & Applications of t-Distribution; Testing Difference between Means of Two Samples (Independent Samples; Dependent Samples)
36-45	Definition of chi-square; Degrees of freedom; chi-square Distribution; Chi-square Test; F-Test. ANOVA.
15 Hours	*Tutorials*

Essential Readings:

- Probability theory for statistical methods by F.N. David
- Statistical Methods by S. P. Gupta

Further Readings:

- Introduction to Survey Sampling by Graham Kalton
- Statistical Methods Vol. II by Das, Tata Mcgraw Hill Education Private Limited

THEORY OF COMPUTATION

Course Details			
Course Title: THEORY OF COMPUTATION			
Course Code	CSC82DE02304	Credits	4
L + T + P	3 + 1 + 0	Course Duration	One Semester
Semester		Contact Hours	45 (L) + 15 (T) Hours
Course Type	Discipline based Elective		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, assignments.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- Students become familiar to mathematical foundation of computer.
- Students become formal languages and grammar
- Becomes known to the meaning of algorithm and complexity
- Become known to decidability problems.

Course Learning Outcomes:

The student will be able to:

- Understand the meaning of algorithms and complexity.
- Understand the key factors like computability, reducibility, NP problems etc.
- Able to understand models of computation, the formal languages and grammar.
- Understand and design the finite automata, pushdown automata, Turing machine etc.
- Able to determine whether a language belong to proper language family.

Pre-requisites: Discrete Mathematics

Course Contents:

UNIT : I **[20% Weightage]**

Introduction to Automata: Study and Central concepts of automata theory, An informal picture of finite automata, deterministic and non-deterministic finite automata, application of finite automata, finite automata with epsilon transitions, Mealy and Moore machine.

UNIT : II **[20% Weightage]**

Regular Expression and Languages: Chomsky's classification- type 0, type 1, type 3 and type 4 languages, Regular expression, finite automata and regular expressions, applications of regular expressions, algebraic laws of regular expressions

UNIT : III **[20% Weightage]**

Properties of Regular Language: Proving languages not to be regular, closure properties of regular languages, equivalence and minimization of automata.

Context-free Grammars and Languages: Parse trees, Applications of context free grammars, Ambiguity in grammars and languages.

UNIT : IV **[20% Weightage]**

Pushdown Automata: Pushdown automation (PDA), the language of PDA, equivalence of PDA's and CFG's, deterministic pushdown automata

Properties of Context-Free Languages: Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages.

UNIT : V **[20% Weightage]**

Introduction to Turing Machine: The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing Machines, Turing machines and Computers, Undecidable Problem about Turing Machine.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Study and Central concepts of automata theory

2-6	An informal picture of finite automata, deterministic and non-deterministic finite automata
6-9	Application of finite automata, finite automata with epsilon transitions, Mealy and Moore machine
10-11	Chomsky's classification- type 0, type 1, type 3 and type 4 languages
12-13	Regular expression
14-18	finite automata and regular expressions, applications of regular expressions, algebraic laws of regular expressions
19-21	Proving languages not to be regular, closure properties of regular languages,
22-24	Equivalence and minimization of automata.
25-27	Parse trees, Applications of context free grammars, Ambiguity in grammars and languages.
28-29	Pushdown automation (PDA), the language of PDA,
30-31	equivalence of PDA's and CFG's, deterministic pushdown automata
32-36	Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages.
37-42	The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing Machines,
43-45	Turing machines and Computers, Undecidable Problem about Turing Machine.
15 Hours	*Tutorials*

Essential Readings:

1. Introduction to Automata Theory, Languages, and Computation, by John E. Hopcroft, Rajeev Motwani, and Jeffery D. Ullman, Pearson Education

2. Theory of Computer Science (Automata, Languages and Computation), 2e, K. L. P. Mishra and N. Chandrasekharan, Pearson Education.

Further Readings:

1. Introduction to formal languages, Automata Theory and Computation by Kamla Krithivasan and Rama R, Pearson Education.

BIG DATA ANALYTICS

Course Code	CSC91DE02404	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Special Nature/ Category of the Course (*if applicable*)	Skill Based		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives:

- Understand the concept and challenge of big data and why existing technology is inadequate to analyze the big data.
- Collect, manage, store, query, and analyze various form of big data.

- Gain hands-on experience on large-scale analytics tools to solve some open big data problems.
- Understand the impact of big data for business decisions and strategy.
- Understand, and practice big data analytics and machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on industry applications

Course Learning Outcomes:

- Ability to identify the characteristics of datasets and compare the trivial data and big data for various applications.
- Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
- Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
- Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
- Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
- Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and map reduce.

Prerequisites: Basic of Computer science, Algorithms, Data structure

Course Contents:

UNIT I

INTRODUCTION TO BIG DATA

Big Data – Definition, History and Paradigms - 3V's of Big Data – Types of data – tructured – Semi-Structured - Unstructured - Traditional Data Vs Big Data – Big Data value chain - Applications of Big Data - System challenges facing big data

[20% Weightage]

UNIT II

BIG DATA STORAGE

Bottlenecks of traditional storage techniques – CAP theorem– Introduction to NoSQL–Types of NoSQL– Key-value store -Column-value store-Document-value store – Graph store– Advantages of NoSQL – NoSQL challenges

[20% Weightage]

UNIT III

BIG DATA ANALYTICS

Big data and analytics – Applications – Nomenclature – Analytic Process Model - Challenges that Prevent Businesses from Capitalizing on Big Data – Importance of analytics - Data Science - Analytics application types

[20% Weightage]

UNIT IV

CLASSIFICATION OF ANALYTICS

Predictive analytics – Descriptive analytics – Survival analytics – Social network analytics – Example applications

[08% Weightage]

UNIT V

HADOOP AND MAPREDUCE FRAMEWORK

The Hadoop Framework – History of Hadoop –Advantages and Disadvantages of Hadoop – HDFS architecture– Features of HDFS– Map Reduce Framework, Feature of MapReduce, Working of MapReduce.

[20% Weightage]

UNIT VI

BIG DATA VISUALIZATION

Importance of Data Visualization–Classification of Visualization-Terminology– Visual data analysis and exploration –Basic charts and plots–Principles of perception, color and design– text data visualization – Effective visualization of big data

[12% Weightage]

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-5	**INTRODUCTION TO BIG DATA** Big Data – Definition, History and Paradigms - 3V's of Big Data – Types of data – tructured – Semi-Structured - Unstructured - Traditional Data Vs Big Data – Big Data value chain - Applications of Big Data - System challenges facing big data
6-15	**BIG DATA STORAGE** Bottlenecks of traditional storage techniques – CAP theorem– Introduction to NoSQL–Types of NoSQL– Key-value store-Column-value store-Document-value store – Graph store–Advantages of NoSQL – NoSQL challenges
16-25	**BIG DATA ANALYTICS** Big data and analytics – Applications – Nomenclature – Analytic Process Model - Challenges that Prevent Businesses from Capitalizing on Big Data – Importance of analytics - Data Science - Analytics application types
26-33	**CLASSIFICATION OF ANALYTICS** Predictive analytics – Descriptive analytics – Survival analytics – Social network analytics – Example applications
34-38	**BIG DATA VISUALIZATION** Importance of Data Visualization–Classification of Visualization-Terminology– Visual data analysis and exploration –Basic charts and plots–Principles of perception, color and design–text data visualization – Effective visualization of big data
39-45	**HADOOP AND MAPREDUCE FRAMEWORK**

	The Hadoop Framework – History of Hadoop –Advantages and Disadvantages of Hadoop – HDFS architecture– Features of HDFS– Map Reduce architecture
15 Hours	***Tutorials***

Essential Readings:

1. Analytics in a Big Data World: The Essential guide to data science and its applications by Bary Baesens Wiley India
2. Hadoop: The Definitive Guide, 4th Edition by Tom White O'Reilly
3. Designing Data Visualization by Noab Iliinsky, Julie Steele O'REILLY publication
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J , Martin Flower PEARSON publication
5. Big Data and Analytics by Seema Acharya and Subhasini Chellappan Wiley India
6. Effective Data Visualization From Design Fundamentals to Big Data Techniques by Jeferry Heer O'Reilly

MACHINE LEARNING

Course Code	CSC91DE02504	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- This course will serve as a comprehensive introduction to various topics in machine learning.
- Enabling students to solve various real-life problems using machine learning techniques.

Course Learning Outcomes

On completion of the course students will be expected to:

- Have a good knowledge of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
- Have an understanding of issues of many popular machine learning approaches.
- Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
- Be able to design and implement various machine learning algorithms in a range of real-world applications.

Prerequisites: Machine Learning is a mathematical discipline, and students will benefit from a good background in probability, linear algebra and calculus. Programming experience is essential.

Course Contents:

UNIT-I: **[20% Weightage]**

Introductory Topics, Linear Regression and Feature Selection

UNIT-II: **[10% Weightage]**

Linear Classification

UNIT-III: **[25% Weightage]**

Support Vector Machines, Artificial Neural Networks, Bayesian Learning and Decision Trees.

UNIT-IV: **[15% Weightage]**

Evaluation Measures, Hypothesis Testing, Ensemble Methods

UNIT-V: **[20% Weightage]**

Clustering, Graphical Models

UNIT-VI: **[10% Weightage]**

Learning Theory and Expectation Maximization, Introduction to Reinforcement Learning

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-3	Introductory Topics, Linear Regression
4-8	Feature Selection
9-13	Linear Classification
14-17	Support Vector Machines , Artificial Neural Networks
18-23	Bayesian Learning and Decision Trees.
24-26	Evaluation Measures, Hypothesis Testing
27-31	Ensemble Methods
32-36	Clustering
37-40	Graphical Models
41-45	Learning Theory and Expectation Maximization, Introduction to Reinforcement Learning
15 Hours	*Tutorials*

Essential Readings:

1. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
2. Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Further Readings:

1. "Techniques in Computation Learning"- C.J. Thorton, Chapman & Hall

2. "Machine Learning – An AI Approach" – Michalski, Carbonell, & Mitchell (Eds.)-vol(1,2,3), Morgan Kaufman

3. "Introduction to Machine Learning"- Ethem Alpaydin, MIT Press

4. "Machine Learning" – Tom M. Mitchell, McGraw hill Publication

Course Details			
Course Title: ADVANCED COMPUTER NETWORKS			
Course Code:	CSC91DE02604	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory
Methods of Content Interaction	Lectures, Assignments, Class Tests, Tutorials, Self-Study, Student Presentations		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students about layered architecture the set of functions performed by each layer of the TCP/IP protocol suite which runs the Internet.
- To introduce students about the MAC protocols used in various LANs, MANs, WANs
- To make students understand how the mobility is supported at the Network Layer.
- To make students understand the how the UDP and TCP transport the data.
- To introduce students to different network security protocol used in modern networks

Course Learning outcomes

After the course the students will be able to:

- understand the role and functions of each of the layer below the Application Layer of the TCP/IP protocol
- understand the design issues and challenges arises at each of the layers below the application layer

Course Contents:

UNIT I: Introduction (20% Weightage)

Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols. MAC protocols for high-speed LANS, MANs, and wireless LANs.

UNIT II Network Access Technologies (25% Weightage)

Fast access technologies. (For example, ADSL, Cable Modem, etc.) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, neighbour discovery, auto-configuration, routing. Changes to other protocols.

UNIT III Mobile Networks (25% Weightage)

Mobility in networks, Mobile IP, Security related issues. IP Multicasting. Multicast routing protocols, address assignments, session discovery.

UNIT IV Transport Layer and Network Security (30% Weightage)

UDP, TCP, TCP extensions for high-speed networks, transaction-oriented applications. Other new options in TCP.

Network security: Network security at various layers. Secure-HTTP, SSL, ESP, Authentication header, Key distribution protocols. Digital signatures, digital certificates.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Overview of computer networks
3-5	seven-layer architecture, TCP/IP suite of protocols
6-11	MAC protocols for high-speed LANS, MANs, and wireless LANs
12-14	Fast access technologies. (For example, ADSL, Cable Modem, etc.)
15-20	IPv6: Why IPv6, basic protocol, extensions and options,
21-24	support for QoS, security, neighbour discovery, auto-configuration, routing, Changes to other protocols.
25-29	Mobility in networks. Mobile IP, Security related issues
30-32	IP Multicasting. Multicast routing protocols
33	address assignments, session discovery.
34-36	TCP extensions for high-speed networks, transaction-oriented applications. Other new options in TCP
37-38	Secure-HTTP
39-41	SSL, ESP Authentication header

42-45	Key distribution protocols. Digital signatures, digital certificates.
15 Hours	*Tutorials*

Essential Readings:

1. W. R. Stevens. TCP/IP Illustrated, Volume 1: The protocols, Addison Wesley, 1994.
2. G. R. Wright. TCP/IP Illustrated, Volume 2: The Implementation, Addison Wesley, 1995.
3. W. R. Stevens, TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996.
4. R. Handel, M. N. Huber, and S. Schroeder. ATM Networks: Concepts, Protocols, Applications, Addison Wesley, 1998.
5. W. Stallings, Cryptography and Network Security: Principles and Practice, 2nd Edition, Prentice Hall, 1998.

Suggested Readings:

1. C. E. Perkins, B. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, Addison Wesley, 1997.
2. Peter Loshin, IPv6 Clearly Explained, Morgan Kaufmann, 1999.
3. M. Gonsalves and K. Niles. IPv6 Networks, McGraw Hill, 1998.
4. RFCs and Internet Drafts, available from Internet Engineering Task Force.
5. Articles in various journals and conference proceedings.

Course Details

Course Title: CRYPTOGRAPHY & NETWORK SECURITY

Course Code:	CSC91DE02704	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory
Methods of Content Interaction	Lecture, Assignments, Class Tests, Student Presentations, Tutorials, Self Study		

Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)

Course Objectives

- To introduce students about history of Cryptography and the role of Modern Cryptography in our lives.
- To introduce students about the classic cryptographic protocols and their cryptanalysis.
- To introduce students with modern Symmetric Key Cryptographic Techniques and some potential attacks on them.
- To introduce students with modern Asymmetric Key Cryptographic Techniques and some potential attacks on them.
- To introduce students with modern Cryptographic Hash Functions and some potential attacks on them.
- To introduce students to different network security protocols and various attacks on the networks.

Course Learning outcomes

After the course the students will be able to:

- understand the various Public Key and Private Key cryptographic techniques, their design issues and challenges
- understand the how various cryptanalysis techniques works
- understand the various aspect of network security and the protocols used to secure protocols
- know about various kind of potential attacks on a network

Prerequisite: Discrete mathematics, Some basic knowledge of probability

Course Contents:

UNIT 1 Introduction and Mathematical Foundations (15% Weightage)

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory.

Classical Cryptosystems: Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems, Shannon's Theory

UNIT 2 Symmetric Key Ciphers **(20% Weightage)**

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES)

Cryptanalysis of Symmetric Key Ciphers: Introduction to Linear Cryptanalysis, Differential Cryptanalysis, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

UNIT 3 **(40% Weightage)**

Stream Ciphers and Pseudo randomness: Stream Ciphers, Pseudorandom functions, Hash Stream Ciphers and Pseudo randomness: Stream Ciphers - RC4, Pseudorandom functions, Hash Functions and MACs, The Merkle-Damgard Construction, Security of Hash Functions.

Asymmetric Key Ciphers Construction and Cryptanalysis: The RSA Cryptosystem, attacks on RSA. Diffie-Hellman Key Exchange algorithm, the ElGamal Encryption Algorithm.

Digital Signatures: DSA algorithm, Schnorr Signature scheme, ElGamal Signature scheme.

UNIT 4 **(25% Weightage)**

Modern Trends in Asymmetric Key Cryptography: Elliptic curve-based cryptography basics, Introduction to Elliptic curve based cryptographic techniques

Network Security: Secret Sharing Schemes, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Introduction, Overview on Modern Cryptography
3-5	Number Theory, Probability and Information Theory
6-9	Classical Cryptosystems
10-12	Cryptanalysis of Classical Cryptosystems
13-15	Shannon's Theory

16-17	Symmetric Key Ciphers, Modern Block Ciphers (DES)
18-20	Introduction to Linear Cryptanalysis, Differential Cryptanalysis, Overview on S-Box Design Principles
21-22	Modes of operation of Block Ciphers
23-23	Stream Ciphers - RC4
24-24	Pseudorandom functions
25-30	Hash Functions and MACs
31-32	The RSA Cryptosystem, attacks on RSA
33-33	Diffie-Hellman Key Exchange algorithm and Man-in-middle attack
34-34	ElGamal Encryption Algorithm
35-37	DSA algorithm, Schnorr Signature scheme, ElGamal Signature scheme
38-40	Elliptic curve-based cryptography basics, Introduction to Elliptic curve based cryptographic techniques
41-42	Secret Sharing Schemes, Kerberos
43-44	Pretty Good Privacy (PGP), Secure Socket Layer (SSL)
45-45	Intruders and Viruses, Firewalls
15 Hours	*Tutorials*

Essential Readings:

1. Douglas Stinson, “Cryptography Theory and Practice", 2nd Edition, Chapman & Hall/CRC.
2. B.A. Forouzan, "Cryptography & Network Security", Tata McGraw Hill.
3. W. Stallings, "Cryptography and Network Security", Pearson Education.

Suggested Readings:

4. J. Daemen, V. Rijmen, “The Design of Rijndael ", Springer.
5. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
6. A. Joux, "Algorithmic Cryptanalysis", CRC Press.
7. C. Boyd, A. Mathuria, "Protocols for Authentication and Key Establishment", Springer.
8. Hoffstein, Pipher, Silverman, "An Introduction to Mathematical Cryptography", Springer.
9. Matt Bishop, "Computer Security", Pearson Education.

SOFTWARE TESTING

Course Code	CSC91DE02804	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Special Nature/ Category of the Course (*if applicable*)	Skill Based		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives :

- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.
- To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.
- To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
- To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions.
- To gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects.

Course Learning Outcomes :

After going through this course a student should be able to:

- Have an ability to apply software testing knowledge and engineering methods.
- Have an ability to design and conduct a software test process for a software testing project.
- Have an ability to identify the needs of software test automation, and define and develop a test tool to support test automation.
- Have an ability understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
- Have an ability to use various communication methods and skills to communicate with their teammates to conduct their practice-oriented software testing projects.
- Have basic understanding and knowledge of contemporary issues in software testing, such as component-based software testing problems
- Have an ability to use software testing methods and modern software testing tools for their testing projects.
- Have an ability to analyze requirements to determine appropriate testing strategies

Prerequisites: Basic of Computer science, software Engg and Programming concept

Course Contents:

UNIT-I

Testing fundamentals: Error, fault and failure, Test Oracles, Test cases and Test criteria, Psychology of Testing, **A Strategic Approach to Software Testing:** Verification and validation, Organizing for Software Testing, A Software Testing Strategy for Conventional Architectures.

[10% Weightage]

UNIT-II

Strategic Issues: Test Strategies for Conventional Software, Unit Testing, Integration Testing, Validation Testing, Validation Test Criteria, Configuration Review, Alpha and Beta Testing, **System Testing:** Recovery Testing, Security Testing, Stress Testing, Performance Testing.

[20% Weightage]

UNIT-III

Testing Tactics: Software Testing Fundamental, Black-Box and White-Box Testing **Basis Path Testing:** Flow Graph Notation, Independent Program Paths, Deriving Test Cases, Graph Matrices

[25% Weightage]

UNIT-IV

Control Structure Testing: Condition Testing, Data Flow Testing, Loop Testing **Black-Box Testing:** Graph-Based Testing Methods, Equivalence Partitioning, Boundary Value Analysis, Orthogonal Array Testing

[25% Weightage]

UNIT-V

The Art of Debugging: The debugging Process, Psychological Considerations, Debugging Strategies, Correcting the Error.

[10% Weightage]

UNIT-VI

Testing Tools: Static Testing Tools, Dynamic Testing Tools, Debugging Tools., Characteristics of Modern Tools.

[10% Weightage]

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion	**Unit/Topic/Sub-Topic**

(Each session of 1 Hour)	
1-2	**Testing fundamentals**: Error, fault and failure, Test Oracles, Test cases and Test criteria, Psychology
3-8	**A Strategic Approach to Software Testing:** Verification and validation, Organizing for Software Testing, A Software Testing Strategy for Conventional Architectures.
9-12	**Strategic Issues:** Test Strategies for Conventional Software, Unit Testing, Integration Testing, Validation Testing, Validation Test Criteria, Configuration Review, Alpha and Beta Testing
13-16	**System Testing:** Recovery Testing, Security Testing, Stress Testing, Performance Testing
17-20	**Testing Tactics:** Software Testing Fundamental , Black-Box and White-Box Testing
21-30	**Basis Path Testing :** Flow Graph Notation, Independent Program Paths, Deriving Test Cases, Graph Matrices
31-35	**Control Structure Testing :** Condition Testing, Data Flow Testing, Loop Testing
36-40	**Black-Box Testing:** Graph-Based Testing Methods, Equivalence Partitioning, Boundary Value Analysis, Orthogonal Array Testing
41-45	**The Art of Debugging:** The debugging Process, Psychological Considerations, Debugging Strategies, Correcting the Error, Debugging Tools. **Testing Tools:** Static Testing Tools, Dynamic Testing Tools, Characteristics of Modern Tools.
15 Hours	*Tutorials*

Essential Readings:

1. Software Testing (2nd Edition) by Ron Patton, Sams Publishing.
2. Software Testing by Yogesh Singh, Cambridge University Press.
3. Software Engineering : A Practitioner's Approach by Pressman, MGH.
4. Software Engineering, by Sommerville, Pearson education.
5. Fundamentals of Software Engineering by Rajib Mall, PHI

SOFT COMPUTING

Course Details			
Course Title: SOFT COMPUTING			
Course Code	CSC91DE02904	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline based Elective		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, seminar, presentations by students, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To familiarize with soft computing concepts.
- To introduce the fuzzy logic concepts, fuzzy principles and relations.
- To provide the basics of ANN and Learning Algorithms.
- Discuss Genetic Algorithm and its applications to soft computing

Course Learning Outcomes

After going through this course a student should be able to:

- Understand basics of fuzzy system, genetic algorithms & their relations.
- Learn artificial neural network models and their functions.

- Apply genetic algorithms & artificial neural networks as computation tools to solve a variety of problems in various areas of interest ranging from optimization problems to text analytics.

Pre-requisites: Artificial intelligence

Course Contents:

UNIT I **[15% weightage]**

Introduction to soft computing - relevance, advantage and importance of soft computing - components of soft computing - applications of soft computing - ability of soft computing to handle uncertainty, vagueness, ambiguity - introduction to computational intelligence - relationship between computational intelligence and soft computing

UNIT II **[20% weightage]**

Introduction to fuzzy sets - t-norms - t-conorms - alpha-cuts - distance between fuzzy sets, fuzzy numbers - extension principle - interval arithmetic and alpha-cuts - properties of fuzzy arithmetic - fuzzy max and min - inequalities

UNIT III **[20% weightage]**

Introduction to fuzzy logic - applications of fuzzy logic - types of membership functions, fuzzy inference system - fuzzifier - defuzzifier - inference engine - rule base, fuzzy rules - mamdani type fuzzy rules - Takagi-Sugeno type fuzzy rules, introduction to type-2 fuzzy logic and its advantages over type-1 fuzzy logic

UNIT IV **[25% weightage]**

Introduction to genetic algorithm - applications of genetic algorithm - concepts of genes, chromosomes, population and its initialization - fitness function - types of selection mechanism, working of roulette wheel selection - types of crossover operations - working of one point, two point, multipoint and arithmetic crossovers - mutation - reinsertion - steps of simple genetic algorithm

UNIT V **[20% weightage]**

Introduction to biological neurons - Introduction to artificial neurons - types of transfer functions - architecture of feedforward neural networks - backpropagation learning algorithm - applications of neural network

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-10	Introduction to soft computing - relevance, advantage and importance of soft computing - components of soft computing - applications of soft computing - ability of soft computing to handle uncertainty, vagueness, ambiguity - introduction to computational intelligence - relationship between computational intelligence and soft computing
11-21	Introduction to fuzzy sets - t-norms - t-conorms - alpha-cuts - distance between fuzzy sets, fuzzy numbers - extension principle - interval arithmetic and alpha-cuts - properties of fuzzy arithmetic - fuzzy max and min - inequalities
22-30	Introduction to fuzzy logic - applications of fuzzy logic - types of membership functions, fuzzy inference system - fuzzifier - defuzzifier - inference engine - rule base, fuzzy rules - mamdani type fuzzy rules - Takagi-Sugeno type fuzzy rules, introduction to type-2 fuzzy logic and its advantages over type-1 fuzzy logic
31-38	Introduction to genetic algorithm - applications of genetic algorithm - concepts of genes, chromosomes, population and its initialization - fitness function - types of selection mechanism, working of roulette wheel selection - types of crossover operations - working of one point, two point, multipoint and arithmetic crossovers - mutation - reinsertion - steps of simple genetic algorithm
39-45	Introduction to biological neurons - Introduction to artificial neurons - types of transfer functions - architecture of feedforward neural networks - backpropagation learning algorithm - applications of neural network

15 Hours	*Tutorials*

Essential Readings:

1. James J. Buckley, EsfandiarEslami, An introduction to fuzzy logic and fuzzy sets, Springer International edition, 2002
2. S.N. Sivanandam, S.N. Deepa, Introduction to genetic algorithms, Springer, 2008
3. S. Sivanandam, S. Sumathi, Introduction to Neural Networks using Matlab 6.0, The McGraw-Hill, 2005
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 2nd ed., Wiley India

Further Readings:

1. Fuzzy Logic: Intelligence, Control, and Information, 1/E, Yen &Langari, 1999, Prentice Hall
2. Neural Networks and Learning Machines, 3/E, Haykin, 2009, Prentice Hall
3. Fuzzy Logic and Control: Software and Hardware Applications, Vol. 2, 1/E, Jamshidi, Vadiee& Ross, 1993, Prentice Hall
4. Genetic Algorithms in Search, Optimization, and Machine Learning, 1/E, Goldberg, 1989, Addison-Wesley

Timothy J. Ross, Fuzzy logic with engineering applications, 3rded, Wiley India

DIGITAL IMAGE PROCESSING

Course Details			
Course Title: DIGITAL IMAGE PROCESSING			
Course Code	CSC91DE03004	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline based Elective		

Nature of Course	Theory
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students, individual and group drills, group and individual field based assignments followed by workshops and seminar presentation.
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)

Course Objectives

- To learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- To understand wavelets and transform of image using wavelets.
- Be familiar with image compression techniques.
- Learn different encoding techniques.

Course Learning Outcomes

After completion of the course the learners will be able to:

- Understand the digital images both grayscale and colour images.
- Understand difference between spatial domain and frequency domains of images.
- Become able to find out transform of images.
- Become able to understand image compression and performance criterion.

Course Contents:

UNIT I: Introduction: [25% Weightage]

Introduction to digital image processing, Different imaging domain, image formation in human eye, Concept of brightness, Gray scale and Colour images, Basics of MATLAB, Digital image representation: Coordinate Convention, Images as matrices, classes and image types, sampling and quantization. Spatial and Intensity Resolution, Image Interpolation, neighbor, Adjacency,Connectivity, Regions,Distance Measures, Introduction to mathematical tools

UNIT II: Spatial Domain and Frequency domain Filtering: [30% Weightage]

Spatial Domain Filtering: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters,

Frequency domain Filtering: Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering: Low pass and High pass filter,

Model of Image Degradation/restoration process – Noise models – Least mean square filtering

UNIT III: Wavelets and applications [15%Weightage]

Introduction to Wavelets: Introduction, admissibility criteria, scaling and wavelet function, Multiresolution analysis, wavelet transform: continuous wavelet transform, discrete wavelet transform,

Application of wavelet transform: discrete wavelet transform for digital image, properties: separable, scalability, orthogonal; fast wavelet transform, inverse fast wavelet transform, some application of wavelet transform of images.

UNIT IV: Image Compression [15% Weightage]

Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Run length Coding, Discrete Wavelet Transform based image compression.

Performance Criterion:- Mean Square Error, Peak Signal to noise ratio for images.

UNIT V: Morphological Image Processing [15% Weightage]

Morphological Image Processing: Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**

1-4	Introduction to digital image processing, Different imaging domain, image formation in human eye, Concept of brightness,
5-7	Gray scale and Colour images, Basics of MATLAB, Digital image representation: Coordinate Convention, Images as matrices, classes and image types,
8-12	sampling and quantization. Spatial and Intensity Resolution, Image Interpolation, neighbor, Adjacency,Connectivity, Regions,Distance Measures, Introduction to mathematical tools
13-17	**Spatial Domain Filtering:** Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters,
18-21	**Frequency domain Filtering**: Fourier Transforms and properties, FFT, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering: Low pass and High pass filter.
22-25	Model of Image Degradation/restoration process – Noise models – Least mean square filtering
26-28	**Introduction to Wavelets:** Introduction, admissibility criteria, scaling and wavelet function, Multiresolution analysis, wavelet transform: continuous wavelet transform, discrete wavelet transform,
29-33	**Application of wavelet transform:** discrete wavelet transform for digital image, properties: separable, scalability, orthogonal; fast wavelet transform, inverse fast wavelet transform, some application of wavelet transform of images.
34-36	Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Run length Coding,
37-40	Discrete Wavelet Transform based image compression.

	Performance Criterion:- Mean Square Error, Peak Signal to noise ratio for images
41-45	**Morphological Image Processing:** Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components
15 Hours	*Tutorials*

Essential Readings:

- Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.
- Digital Image Processing Using MATLAB, 2nd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.
- Fundamentals of Digital Image Processing by Anil K Jain. Publisher: PHI, New Delhi
- Insight into Wavelets From Theory to Practice By K. P. Soman, K.I. Ramchandran, N. G. Resmi, Publisher: PHI Learning Pvt. Ltd.
- An Introduction to Wavelets by C. K. Chui, Publisher: Academic Press, UK London.

SPEECH PROCESSING AND RECOGNITION

Course Code	CSC91DE03104	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, presentations by students, assignments.		

Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)

Course Objectives

- To introduce students to the basic concepts of speech production and perception mechanisms in human beings.
- To provide a broad overview of speech signal processing methods.
- To provide the knowledge of various speech tools for recording speech signals and also extracts different speech features from the recorded speech files.
- To develop speech and speaker recognition systems using various modelling techniques

Course Learning Outcomes

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

- Describe the mechanisms of human speech production and perception systems.
- Familiar with various information present in the speech signal.
- Extract various source and system features from the speech signal.
- Develop speech and speaker recognition systems using modelling techniques.

Prerequisites: None

Course Contents:

UNIT II **[15% Weightage]**

Introduction: Speech production and perception mechanisms, Speech Signal Processing Methods.

UNIT II **[20% Weightage]**

Knowledge sources in speech: Time domain and frequency domain, Spectrograms, Knowledge sources at segmental, sub-segmental and supra-segmental (prosodic) levels, excitation source, vocal tract system.

UNIT III **[25% Weightage]**

Modeling techniques for developing speech systems: Vector quantization, Hidden Markov models, Gaussian mixture models, Support vector machines and Neural networks.

UNIT IV **[25% Weightage]**

Speech Recognition: Issues in speech recognition, Isolated word recognition, Connected word recognition, Continuous speech recognition, Large vocabulary continuous speech recognition. **Speaker Recognition**: Issues in speaker recognition, Speaker verification vs identification, Text dependent vs text independent speaker recognition, Development of speaker recognition systems.

UNIT V **[15% Weightage]**

Introduction to some advanced topics: speech coding and text-to-speech synthesis.

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-11	**Introduction**: Speech production and perception mechanisms, Speech Signal Processing Methods.
12-19	**Knowledge sources in speech**: Time domain and frequency domain, Spectrograms, Knowledge sources at segmental, sub-segmental and supra-segmental (prosodic) levels, excitation source, vocal tract system.
20-30	**Modeling techniques for developing speech systems**: Vector quantization, Hidden Markov models, Gaussian mixture models, Support vector machines and Neural networks.

31-38	**Speech Recognition**: Issues in speech recognition, Isolated word recognition, Connected word recognition, Continuous speech recognition, Large vocabulary continuous speech recognition.
39-41	**Speaker Recognition**: Issues in speaker recognition, Speaker verification vs identification, Text dependent vs text independent speaker recognition, Development of speaker recognition systems.
41-45	**Introduction to some advanced topics:** speech coding and text-to-speech synthesis.
15 Hours	*Tutorials*

Essential Readings:

- D. O Shaughnessy, Speech Communication: Human and Machine, 2nd edition, IEEE Press, NY, USA, 1999.
- J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis, Discrete-time Processing of Speech Signals, IEEE Press, NY, USA, 1999.
- T.F. Quateri, Discrete-Time Speech Signal Processing: Principles and Practice, Pearson Education, 2004.

Further Readings:

- L. R. Rabiner and B. H. Juang, Fundamentals of Speech Recognition, Pearson Education, Delhi, India, 2003.
- B. Gold and N. Morgan, Speech and Audio Signal Processing, Wiley Student Edition, Singapore, 2004.
- Ahmet M. Kondoz, Digital Speech: Coding for Low Bit Rate Communication, 2nded, Wiley publication, 2004.
- IEEE Trans. on Speech and Audio Processing.
- Speech Communication (Elsevier)
- Computer, Speech and Language (Elsevier)

Social Networks

Course Title:	**Social Networks**		
Course Code	CSC91DE03204	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory/Skill Based
Methods of Content Interaction	Lecture, Tutorials, Class Tests, data analysis, seminar, presentations by students etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Prerequisites: Understanding of Basic Graph Theory

Course Objectives

- To introduce students about the history of Social Networks and the types of social networks and their features
- To introduce them about various centrality measures and their importance in predicting user properties, behaviours and various events in social networks.
- To introduce students about some of the popular network models developed to understand/ mimic real social network formations and their characteristics.
- To introduce students with the concepts of formation of communities in social networks and introducing them with some of the popular community detection algorithms.
- To introduce students with the concept of strong and weak ties, homophily and their roles in topological evolution of social networks.
- To understand the concepts of cascading behaviours in social networks.
- To introduce students with common security and privacy concerns in social networks.

Course Learning outcomes

After the course the students:

- would understand the types of social networks and their architectures and their applications. They also will become familiar with popular public dataset for different types of social networks.
- would know about various centrality measures and their usage and roles in prediction variety of characteristics of nodes, edges and social networks.
- would become familiar with some of popular models proposed to understand evolution/formation of real social networks and their characteristics
- would understand the concepts of communities in social networks, their formation process and detecting the existing communities using some of the popular algorithms.
- would understand the concepts of strong and weak ties, homophily and selection and social influence and impact of these phenomena on dynamics of a social network.
- would become familiar with the basic concepts of cascading behaviour in social network
- would be able to understand the privacy and security issues with social networks

Course Contents:

UNIT 1 Introduction to Online Social Networks (20% Weightage)

History of Online Social Networks, definition, types of social networks and their features like architecture, various social network datasets

UNIT 2 Topology and Centrality Measures of Social Networks (20% Weightage)

Topology of a social network, Degree Centrality, Closeness Centrality, Betweenness Centrality, Eigenvector centrality, clustering coefficient, applications of centrality metrics.

UNIT 3 Network Models and Communities (30% Weightage)

Random Networks: Erdos-Renyi and Barabasi-Albert Model and their properties, Scale-Free

networks and their properties, Power Law Distribution, Small-world Networks

Community structures and community detection algorithms: Girvan–Newman algorithm

UNIT 4 Human Behaviour Dynamics **(30% Weightage)**

Strong and Weak Ties, Homophily, Selection and Social Influence, Cascading Behaviour in Networks, Understanding and predicting human behaviour for social communities. Privacy issues in online social networks,

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	History of Online Social Networks, definition
3-5	Types of social networks and their architecture
6-9	Degree Centrality, Closeness Centrality, Betweenness Centrality
10-13	Eigenvector centrality, clustering coefficient, applications of centrality metrics
14-18	Random Networks: Erdos-Renyi and Barabasi-Albert Model and their properties
19-22	Scale-Free networks and their properties
23-26	Power Law Distribution and its examples
27-29	Small-world Networks

29-34	Community structures and community detection algorithms: Girvan–Newman algorithm
35-37	Strong and Weak Ties
37-38	Homophily
39-40	Selection and Social Influence
40-41	Cascading Behavior in Networks
42-43	Understanding and predicting human behavior for social communities
43-45	Privacy issues in online social networks
15 Hours	Tutorials

Essential Readings:

1. Network Science 1st Edition by Albert-László Barabasi, Cambridge University Press, ISBN-13: 978-1107076266
2. Analyzing Social Networks Second Edition by Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson SAGE Publications Ltd ISBN-13: 978-1526404107.
3. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
4. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.

Suggested Readings:

1. Guandong Xu, Yanchun Zhang and L in Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011
2. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009
3. Dion Goh and Schubert Foo, "Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.

COMPILER DESIGN

Course Code	CSC91DE03404	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, self-study, seminar, presentations by students, assignments.		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce the major concept areas of language translation and compiler design.
- To describe various phases of compiler and their interaction with symbol table
- To extend the knowledge of parser by describing LL parser and LR parser.
- To provide programming skills necessary for constructing a compiler.

Course Learning Outcomes

- To apply the knowledge of lex tool & yacc tool to develop a scanner & parser.
- To design Intermediate Code Generation using syntax-directed shceme.
- To learn & use the new tools and technologies used for designing a compiler

Prerequisites: Theory of computation and computer organization.

Course Contents:

UNIT I **(15% weightage)**

Translators, Various phases of compiler, tool based approach to compiler construction.

Lexical analysis: token, lexeme and patterns, difficulties in lexical analysis, error reporting, implementation, regular definition, transition diagrams, LEX.

UNIT II **(25% weightage)**

Syntax Analysis: top down parsing (recursive descent parsing, predictive parsing), operator precedence parsing, bottom-up parsing (SLR, LALR, Canonical LR), YACC.

Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom-up and top-down evaluation of attributes, L-attributed and S-attributed Definitions.

UNIT III **(20% weightage)**

Type checking: type system, type expressions, structural and name equivalence of types, type conversion.

Run time system: storage organization, activation tree, activation record, parameter passing, dynamic storage allocation, symbol table: hashing, linked list, tree structures.

UNIT IV **(20% weightage)**

Intermediate code generation: intermediate representation, translation of declarations, assignments, control flow, Boolean expressions and procedure calls, implementation issues.

UNIT V **(20% weightage)**

Code generation: issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peephole optimization.

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-6	Translators, Various phases of compiler, tool based approach to compiler construction. **Lexical analysis:** token, lexeme and patterns, difficulties in lexical analysis, error reporting, implementation, regular definition, transition diagrams, LEX.

6-13	**Syntax Analysis:** top down parsing (recursive descent parsing, predictive parsing), operator precedence parsing, bottom-up parsing (SLR, LALR, Canonical LR), YACC.
14-18	**Syntax directed definitions:** inherited and synthesized attributes, dependency graph, evaluation order, bottom-up and top-down evaluation of attributes, L-attributed and S-attributed Definitions.
15-22	**Type checking:** type system, type expressions, structural and name equivalence of types, type conversion.
23-27	**Run time system:** storage organization, activation tree, activation record, parameter passing, dynamic storage allocation, symbol table: hashing, linked list, tree structures
27-38	Intermediate code generation: intermediate representation, translation of declarations, assignments, control flow, Boolean expressions and procedure calls, implementation issues.
39-45	Code generation: issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peephole optimization
15 Hours	*Tutorials*

Essential Readings:

- Aho, Ullman and Sethi, Principles of Compiler Design, Addison Wesley.
- J. P. Tremblay and P. G. Sorensen, The Theory and Practice of Compiler Writing, McGraw Hill.

Further Readings:

- Holub, Compiler Design in C, PHI.
- Modern Compiler Implementation in C by Appel

ADVANCED PYTHON PROGRAMMING

Course Details			
Course Title: ADVANCED PYTHON PROGRAMMING			
Course Code:	CSC91DE03504	**Credits**	4
L + T + P	3 +0+1	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	45 (L) + 30 (L) Hours
Course Type	Discipline-Based Core Elective	**Nature of the Course**	Skill Based
Methods of Content Interaction	Lectures, Programming, Assignments, Class Tests, Mini Project and viva		
Assessment and Evaluation	● 50% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 50% - End Term External Examination (University Examination)		

Course Prerequisites: Knowledge of at least one of the programming languages

Course Objectives

- To introduce students about characteristics and advantages of Python
- To introduce them with data types, variables, operators, decision making and looping structures
- To introduce them with the details of inbuilt data structures supported by Python such as array, list, dictionary etc.
- To introduce students with user-defined functions and the concept of modules and packages in Python.
- To introduce students to object-oriented programming concepts in Python with error handling, file handling and I/O.
- To introduce students to the libraries and functions offered by Python for doing scientific computations.
- To make them understand how they can access and update databases in Python.
- To introduce students about some important libraries required for data anaysis
- To introduce students about machine learning and libraries

Course Learning outcomes

After the course the students:

- would understand the syntax and usages of basic constructs of Python.
- would be able to write programs using decision-making and looping structures.
- would be able to write programs based on object-oriented programming paradigms.
- would be able to connect, access, and update data stored in the database
- would be able to solve data analytics and machine learning problems by employing scientific computing, machine learning libraries and packages in Python.

Course Contents:

UNIT I Python Basics **(20% Weightage)**

Introduction: History and introduction to python, features of python.

Python Data types and control structures: Python Data types, variables, basic operators, expressions, decision making and loop structures, break, continue and pass statements, strings, arrays, list, dictionary, tuples and dates.

Python Functions: Function in python, local and global variables, passing parameters to functions, return statement library functions, python modules and packages.

Error Handling: Errors and Exception handling

UNIT-II **(15% Weightage)**

Input-Output in Python:

Input/ Output in python, creating files, opening an existing file, reading and writing into a file, file opening modes, closing a file,

UNIT III **(15% Weightage)**

Object-Oriented Programming: Defining class in python, creating an object, initializing an object, defining member function, accessing member function and class data, the *init* method, built-in class attributes, Inheritance, function and operator overloading.

UNIT-IV Accessing database: (15% Weightage)

Connecting with database, retrieving records from database using a select query, processing records retrieved from a database, modifying database using insert, delete and update queries, and closing the connection with a database.

UNIT V Introduction to Scientific **Computation in Python (35% Weightage)**

Introduction to NumPy, Pandas, Scikit-Learn and Matplotlib, NetworkX library

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-1	History and introduction to python, features of python.
2-2	Python Data types, variables, basic operators, expressions
3-4	decision making and loop structures, break, continue and pass statements
4-5	strings, arrays, list, dictionary, tuples and dates
6-7	Function in python, local and global variables, passing parameters to functions, return statement library functions, python modules and packages
8-8	Errors and Exception handling
9-11	Input/ Output in python, creating files, opening an existing file, reading and writing into a file, file opening modes, closing a file

12-16	Defining a class in python, creating an object, initializing an object, defining member function, accessing member function and class data, the *init* method
17-18	built-in class attributes, Inheritance, function and operator overloading
19-21	Connecting with database, retrieving records from database using a select query, processing records retrieved from a database
22-25	modifying database using insert, delete and update queries, and closing the connection with a database.
26-29	Introduction to NumPy
30-34	Pandas
35-40	Scikit-Learn and Matplotlib
41-44	NetworkX library
30 Hours	Programming Lab

Essential Readings:

1. Python: The Complete Reference, Martin C. Brown, 4th edition, McGraw Hill Education, ISBN-10: 9789387572942
2. Python Cookbook, Third edition 3rd Edition, O'Reilly Media, ISBN-13: 978-1449340377
3. Learning Python, 5th Edition by Mark Lutz O'Reilly Media ISBN-13: 978-1449355739.
4. Python Documentation: https://www.python.org/
5. Scikit-learn Machine Learning in Python, https://scikit-learn.org/stable
6. Pandas' documentation, https://pandas.pydata.org/docs
7. Matplotlib: Visualization with Python, https://matplotlib.org
8. NetworkX, Network Analysis in Python, https://networkx.org
9. NumPy documentation, https://numpy.org/doc/stable

Suggesting Reading:

1. Python 3 Object-oriented Programming - Second Edition: Packt Publishing ISBN-13: 978-1784398781

2. Python for Everybody: Exploring Data in Python 3, Dr. Charles Russell Severance, CreateSpace Independent Publishing Platform, ISBN-10: 1530051126

3. Programming Python, 4th Edition by Mark Lutz O'Reilly Media, ISBN: 978-0-596-15810-1.

4. Python in a Nutshell, Second Edition by Alex Martelli, O'Reilly Media, ISBN-13: 978-0596100469.

DATA MINING

Course Code	CSC91DE03604	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives:

- To introduce students to the basic concepts and techniques of Data Mining.
- To incorporate skills of using recent data mining software for solving practical problems.
- Enable students for doing independent study and research.

Course Learning Outcomes :

At the end of the course, students:

- Can define what a typical data mining is and where it can be applied.
- Can determine the different steps in Data mining and pre-processing tasks.
- Are able to apply Association Rule mining.
- Are familiar with a data mining software system and use it for solving data mining problems.
- Can apply at least one of the algorithms for Association rules in data mining.
- Can apply at least one of the Classification methods for data mining.
- Can describe the basics of Clustering approaches.
- Identify the challenges in related advanced applications such as data mining for: Text, Time Series, Web data, Spatial data etc.

Prerequisites: Knowledge of DBMS.

Course Contents :

UNIT I [10% Weightage]

Introduction: What is Data Mining? Motivating Challenges; The origins of data mining; Data Mining Tasks, Types of Data; Data Quality. Data Preprocessing; Measures of Similarity and Dissimilarity.

UNIT II [20% Weightage]

Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Nearest-neighbour classifier.

UNIT III [20% Weightage]

Association Analysis – 1: Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent itemsets; Alternative methods for generating frequent itemsets.

Association Analysis – 2: FP-Growth algorithm, Evaluation of association patterns; Effect of skewed support distribution; Sequential patterns.

UNIT IV [20% Weightage]

Cluster Analysis: Overview, K-means, Agglomerative hierarchical clustering, DBSCAN, Overview of Cluster Evaluation.

UNIT V **[10% Weightage]**

Applications: Data mining applications; Data mining system products and research prototypes; Trends in Data mining.

UNIT VI **[20% Weightage]**

Advanced Techniques: Web Mining, Spatial Mining, Temporal Mining.

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	**Introduction:** What is Data Mining? Motivating Challenges; The origins of data mining; Data Mining Tasks.
6-9	Types of Data; Data Quality. Data Preprocessing; Measures of Similarity and Dissimilarity.
10-14	**Classification:** Preliminaries; General approach to solving a classification problem; Decision tree induction;
15-19	Rule-based classifier; Nearest-neighbour classifier.
20-25	**Association Analysis – 1:** Problem Definition; Frequent Itemset generation; Rule Generation; Compact representation of frequent itemsets; Alternative methods for generating frequent itemsets.
26-30	**Association Analysis – 2:** FP-Growth algorithm, Evaluation of association patterns; Effect of skewed support distribution; Sequential patterns.
31-35	**Cluster Analysis:** Overview, K-means, Agglomerative hierarchical clustering.
36-38	DBSCAN, Overview of Cluster Evaluation.
39-41	**Applications:** Data mining applications; Data mining system products and research prototypes; Trends in Data mining.

42-45	**Advanced Techniques:** Web Mining, Spatial Mining, Temporal Mining.
15 Hours	*Tutorials*

Essential Readings:

- Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, 2007
- Data Mining – Concepts and Techniques - Jiawei Han and Micheline Kamber, 2nd Edition, Morgan Kaufmann, 2006.
- M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
- Insight into Data Mining – Theory and Practice - K.P.Soman, Shyam Diwakar, V.Ajay, PHI
- H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
- D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.

INTERNET OF THINGS

Course Code	CSC91DE03704	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	II	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective Course		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives:

- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and characteristics..

Course Learning Outcomes :

At the end of the course, students:

- Understand the vision of IoT from a global context.
- Determine the Market perspective of IoT.
- Use of Devices, Gateways and Data Management in IoT.
- Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
- Building state of the art architecture in IoT.

Course Contents :

Unit 1 **[20% Weightage]**

Clouds: Introduction to Cloud Computing, Software as a Service SAAS, Infrastructure as a Service IAAS, Platform as a service PAAS, Desktop as a service DAAS

Unit 2 **[20% Weightage]**

FUNDAMENTALS OF IoT: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT

Unit 3 **[20% Weightage]**

Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

Unit 4 **[20% Weightage]**

IoT PROTOCOLS : IoT Access Technologies; Physical and MAC layers, topology and Security of

Unit 5 **[20% Weightage]**

DESIGN AND DEVELOPMENT : Design Methodology ,Microcontroller, System on Chips

IoT system building blocks;

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Clouds: Introduction to Cloud Computing, Software as a Service SAAS, Infrastructure as a Service IAAS,
6-9	Platform as a service PAAS, Desktop as a service DAAS
10-14	FUNDAMENTALS OF IoT: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M,
15-19	IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT
20-25	Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT –
26-30	Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.
31-35	

	IoT PROTOCOLS : IoT Access Technologies; Physical and MAC layers, topology and Security of
36-38	DESIGN AND DEVELOPMENT : Design Methodology ,
39-41	Microcontroller, System on Chips
42-45	IoT system building blocks; .
15 Hours	*Tutorials*

Essential Readings:

- Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More Paperback – 2013
- Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
- Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
- Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011.
- Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015

DATA SECURITY

Course Code	CSC91DE03804	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Discipline Based Core Elective Course		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture*, *Tutorials*, *Group discussion*, *seminar*, *presentations by students*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives:

- Lossless and Lossy compression techniques for different types of data.

  Understand data encryption techniques Network security and ethical hacking.

Course Learning Outcomes :

At the end of the course, students:

- Implement text, audio and video compression techniques.
- Understand symmetric and asymmetric key cryptography schemes.
- Understand network security and ethical hacking.

Course Contents :

Unit 1 **[25%]**

Introduction to Data Compression Data Compression; Modeling and Coding, Statistical Modeling, Dictionary Schemes.

Unit 2 **[25%]**

Image Compression; Video and Audio Compression, Analog Video, Digital Video, Digital Audio. Data Security Goals, Cryptographic Attacks.

Unit 3 **[25%]**

Number Theory and Asymmetric Key Cryptography, Fermat's and Euler's Theorem, Discrete Logarithms Principles of Public Key Cryptosystem, Message Authentication and Hash Functions, Digital Signature Standards.

Unit 4 **[25%]**

Network Security Email, PGP, S/MIME, Intrusion Detection System Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions Kerberos.
Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-9	Introduction to Data Compression Data Compression; Modeling and Coding, Statistical Modeling, Dictionary Schemes.
10-22	Image Compression; Video and Audio Compression, Analog Video, Digital Video, Digital Audio. Data Security Goals, Cryptographic Attacks
23-35	Number Theory and Asymmetric Key Cryptography, Fermat's and Euler's Theorem, Discrete Logarithms Principles of Public Key Cryptosystem, Message Authentication and Hash Functions, Digital Signature Standards.
35-45	Network Security Email, PGP, S/MIME, Intrusion Detection System Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions Kerberos.
15 Hours	*Tutorials*

Essential Readings:

- Khalid Sayood, ― Introduction to Data Compression‖ ,Morgan Kaufmann, 2000
- David Salomon, ―Data Compression: The complete reference‖ , Springer publication
- Behrouz Forouzan, ―Cryptography and Network Security‖, Tata Mc Graw –Hill Education 2011
- Berard Menezes, ―Network Security and Cryptography‖, learning publication Cengage
- William Stallings, ―Cryptography and Network Security‖, Pearson Education Asia Publication, 5th edition.

Mandatory Elective Non-Credit Course (MENCC)

LATEX

Course Code:	CSC82ME03900	**Credits**	Non-Credit
L + T + P		**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	Non-Credit
Course Type	Mandatory Elective Non-Credit Course		
Nature of the Course	Theory/Practical		
Special Nature/ Category of the Course (*if applicable*)	Skill Based		
Methods of Content Interaction	Lecture, Tutorials, self-study, Lab Assignments		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

To enable students understand

- Basics of document preparation using latex.
- To know how to do text formatting in a latex document.
- To insert mathematical symbols and equations in a document
- To insert figures, graphs, charts, images, tables in a document

Course Learning outcomes

After completing the course the students

- Will be able to understand fundamentals of latex and beamer and commonly required packages.
- Will be able prepare variety document like report, papers, thesis, and so on
- Will be able to prepare professional presentation with variety of themes using beamer.

Course Contents:

Unit - 1 **(15% Weightage)**

Installation of the software LaTeX, Understanding Latex compilation, Latex features, general syntax of a document in latex, latex editors.

Unit - 2 **(30% Weightage)**

Formatting the text, defining color for text, fonts, sections and paragraphs, inserting mathematical symbols, writing equations, creating Matrices and Array, Tables in Latex, inserting images, animation and videos , creating lists, common latex packages.

Unit - 3 **(25% Weightage)**

Latex Page Layout, Sections and subsections, Equation references, References and citation in latex, bibliography database

Unit - 4 **(30% Weightage)**

Writing Resume, question paper, articles/research papers, thesis report, creating presentation using beamer.

Essential Readings:

1. LaTeX Beginner's Guide, Stefan Kottwitz, ISBN 13-9781847199867, Packt Publishing Limited.
2. Latex: A Document Preparation System, 2/E, Lamport, Pearson Education India, ISBN 8177584146, 9788177584141

Suggested Readings:

1. More Math Into LaTeX, George Grätzer, Springer, 15-Feb-2016, ISBN 9783319237961.
2. Guide to LaTeX, Tools and Techniques for Computer Typesetting, Helmut Kopka, Patrick W. Daly, Pearson Education, 2003, ISBN 0321617746, 9780321617743
3. https://www.latex-project.org/
4. https://ctan.org/

PYTHON BASICS

Course Details			
Course Title: PYTHON BASICS			
Course Code:	CSC91ME04100	**Credits**	Non-Credit
L + T + P	1+0+1	**Course Duration**	One Semester
Semester	Odd/Even	**Contact Hours**	Non-Credit
Course Type	Mandatory Elective Non-Credit Course	**Nature of the Course**	Skill Based
Methods of Content Interaction	Lectures, Programming, Assignments, Class Tests, Mini Project and viva		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Course Objectives

- To introduce students about features and advantages of Python
- To introduce them with data types, variables, operators, decision making and looping structures
- To introduce them with the details of inbuilt data structures supported by Python such as array, list, dictionary etc.
- To introduce students with user-defined functions and the concept of modules and packages in Python.
- To introduce students to object-oriented programming concepts in Python with error handling, file handling and I/O.
- To make them understand how they can access and update databases in Python.

Course Learning outcomes

After the course the students:

- would understand the syntax and usages of basic constructs of Python.

- would be able to write programs using decision-making and looping structures.
- would be able to write programs based on object-oriented programming paradigms.
- would be able to connect, access, and update data stored in the database

Course Contents:

UNIT I Python Basics **(50% Weightage)**

Introduction: History and introduction to python, features of python.

Python Data types and control structures: Python Data types, variables, basic operators, expressions, decision making and loop structures, break, continue and pass statements, strings, arrays, list, dictionary, tuples and dates.

Python Functions: Function in python, local and global variables, passing parameters to functions, return statement library functions, python modules and packages.

Error Handling: Errors and Exception handling

UNIT-II **(50% Weightage)**

Input-Output in Python:

Input/ Output in python, creating files, opening an existing file, reading and writing into a file, file opening modes, closing a file,

Accessing database:

Connecting with database, retrieving records from database using a select query, processing records retrieved from a database, modifying database using insert, delete and update queries, and closing the connection with a database.

Content Interaction Plan:

Lecture cum Discussion **(Each session of 1 Hour)**	**Unit/Topic/Sub-Topic**
1-1	History and introduction to python, features of python.
2-4	Python Data types, variables, basic operators, expressions
5-6	decision making and loop structures, break, continue and pass statements
7-10	strings, arrays, list, dictionary, tuples and dates
11-13	Function in python, local and global variables, passing parameters to functions, return statement library functions, python modules and packages
14-15	Errors and Exception handling
16-20	Input/ Output in python, creating files, opening an existing file, reading and writing into a file, file opening modes, closing a file
21-25	Connecting with database, retrieving records from database using a select query, processing records retrieved from a database
26-30	modifying database using insert, delete and update queries, and closing the connection with a database

Essential Readings:

1. Python: The Complete Reference, Martin C. Brown, 4th edition, McGraw Hill Education, ISBN-10 : 9789387572942
2. Python Cookbook, Third edition 3rd Edition, O'Reilly Media, ISBN-13: 978-1449340377
3. Python Documentation: https://www.python.org/

Suggesting Reading:

1. Programming Python, 4th Edition by Mark Lutz, O'Reilly Media, Inc., ISBN: 9780596158101
2. Learning Python, 5th Edition, Mark Lutz O'Reilly Media ISBN-13: 978-1449355739.
3. Python in a Nutshell, Second Edition by Alex Martelli, O'Reilly Media, Inc., ISBN-13: 978-0596100469.

SOCKET PROGRAMMING USING PYTHON

Course Details			
Course Title: SOCKET PROGRAMMING USING PYTHON			
Course Code:	CSC82ME04000	**Credits**	Non-Credit
L + T + P	1+0+1	**Course Duration**	One Semester
Semester		**Contact Hours**	Non-Credit
Course Type	Discipline Based Core Elective	**Nature of the Course**	Theory/Lab/Skill Based
Methods of Content Interaction	Lecture, Tutorials, self-study, Class Tests, Home Assignments, mini project		
Assessment and Evaluation	● 50% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 50% - End Term External Examination (University Examination)		

Prerequisite: Some basic knowledge of Programming in Python

Course Objectives

The objective of the course is

- To make students understand the concept of socket, client-server architecture
- To enable students, create client and server sockets and make them communicate with each other using TCP or UDP protocol.
- To enable students, understand how client and server communicates using HTTP, FTP and SMTP protocol

Course Learning outcomes

After completing the course, the students

- Will be able to create client and server processes that can communicate using TCP or UDP.
- Will be able to send HTTP, FTP, SMTP requests to the server and enable server to process them as per these protocols respectively.

Course Content

UNIT I **(50% Weightage)**

Introduction to Socket: Client Server Architecture, Concept of Socket, vocabulary of sockets, socket family types and protocols, client socket methods, server socket methods, general socket methods.

TCP Socket: Creating TCP client socket and TCP server socket, binding socket to address, sending request to TCP server, processing the request from client at server. Closing the connection

UDP Socket: Creating UDP client and Server Socket, sending a UDP request to the UDP server, processing a DCP request.

UNIT II **(50% Weightage)**

HTTP: Serving HTTP requests from your machine Extracting cookie information after visiting a website Submitting web forms , Sending web requests through a proxy server,

FTP: Communicating with an FTP server using FTP

SMTP: Sending email using SMTP.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Client Server Architecture, Concept of Socket
3-3	vocabulary of sockets, socket family types and protocols
4-5	client socket methods, server socket methods,
6-7	general socket methods.
6-7	**TCP Socket:** Creating TCP client socket and TCP server socket

7-7	binding socket to address, sending request to TCP server, processing the request from client at server. Closing the connection
8-9	Creating UDP client and Server Socket, sending a UDP request to the UDP server, processing a UDP request.
11-11	Serving HTTP requests from your machine
12-13	Extracting cookie information after visiting a website Submitting web forms, Sending web requests through a proxy server
14-14	FTP**:** Communicating with an FTP server using FTP
15-15	SMTP: Sending email using SMTP.
30 Hours	Lab

Essential Readings:

1. Python Network Programming Cookbook by M Omar Faruque Sarker, Packt Publishing Limited, ISBN-13: 978-1849513463.
2. Learning Python Network Programming, by M. O. Faruque Sarker Sam Washington, Packt Publishing Limited, ISBN-13: 978-1849513463.
3. TCP/IP Illustrated, Volume 3, by W. Richard Stevens Addison Wesley, ISBN-13: 978-0201634952.

Suggested Readings:

1. Computer Networking, by Kurose & Ross, Pearson Education
2. Computer Network, A system approach; Larry L. Peterson & Bruce. S. Davie .the Morgan Kaufmann Series.
3. Data Communications and Networks, by Forouzan, TMH

Open Elective (interdisciplinary) Basket for other departments

PROGRAMMING IN C

Course Details			
Course Title: PROGRAMMING IN C			
Course Code	CSC82OE04204	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester		**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Interdisciplinary Course		
Nature of Course	Theory		
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations by students		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To understand computer programming and its roles in problem solving
- To convert algorithm in program.
- To understand and develop well-structured programs using C language
- To learn the basic data structures through implementing in C language

Course Learning Outcomes

After completion of the course the learners will be able to:

- Problem solving through computer programming
- Familiarity of programming environment
- To use different memory allocation methods
- To deal with different input/output methods

- To use different data structures

Course Contents:

UNIT I: Introduction to 'C' language: (20% Weightage)

Character set, variables and identifiers, built-in data types. variable definition, arithmetic operators and expressions, constants and literals, simple assignment statement, basic input/output statement, simple 'c' programs.

UNIT II: Conditional statements and loops: (20% Weightage)

Decision making within a program, conditions, relational operators, logical connectives, if statement, if-else statement, loops: while loop, do while, for loop. nested loops, infinite loops, switch statement, structured programming.

UNIT III: Functions (20% Weightage)

Functions: top-down approach of problem solving, modular programming and functions, prototype of a function, function call, block structure, passing arguments to a function: call by reference, call by value, recursive functions, arrays as function arguments.

UNIT IV: Array, Structure and Union (20%Weightage)

Arrays: one dimensional arrays: array manipulation; searching, insertion, deletion of an element from an array; finding the largest/smallest element in an array; two dimensional arrays, addition/multiplication of two matrices, transpose of a square matrix.

Structures and unions: structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions.

UNIT V: Pointers and File Processing (20% Weightage)

Pointers: address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, arrays and pointers.

File processing: concept of files, file opening in various modes and closing of a file, reading from a file, writing onto a file

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-4	Character set, variables and identifiers, built-in data types. variable definition, arithmetic operators and expressions,
5-9	Constants and literals, simple assignment statement, basic input/output statement, simple 'c' programs.
10-14	**Conditional Statements:** Decision making within a program, conditions, relational operators, logical connectives, if statement, if-else statement, loops:
15-18	**Looping:** while loop, do while, for loop. nested loops, infinite loops, switch statement, structured programming.
19-23	**Functions:** top-down approach of problem solving, modular programming and functions, prototype of a function, function call, block structure.
24-28	**Passing arguments to a function:** call by reference, call by value, recursive functions, arrays as function arguments.
29-33	**Arrays:** one dimensional arrays: array manipulation; searching, insertion, deletion of an element from an array; finding the largest/smallest element in an array; two dimensional arrays, addition/multiplication of two matrices, transpose of a square matrix.
34-36	**Structures and unions:** structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions.
37-41	**Pointers:** address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, arrays and pointers.
42-45	**File processing:** concept of files, file opening in various modes and closing of a file, reading from a file, writing onto a file

15 Hours	*Tutorials*

Essential Readings:

- B.W. Kernighan and D.M.Ritchie, the C Programming Language, PHI.
- B.S. Gottfried, Schaum's Outline of Theory and Problems of Programming with C, McGraw-Hill.
- R.C. Hutchinson and S.B. Just, Programming using the C Language, McGraw-Hill
- Programming in ANSI C by E Balagurusamy.
- "Let Us C" written by Yashavant Kanetkar.

FUNDAMENTALS OF COMPUTERS

Course Code	CSC82OE04304	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Open Elective		
Nature of the Course	Theory		
Methods of Content Interaction	*Lecture, Tutorials, Group discussion, seminar, presentations by students*		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives:

- Students will understand the concept of fundamentals of Computer, Assembly language, high level language
- Will give the idea of compiler, assembler and operating systems

Course Learning Outcomes:

- Student will be able to identify the components of a personal computer system

- Student will be able to demonstrate mouse and keyboard functions
- Student will be able to demonstrate window and menu commands and how they are used

Course Contents:

UNIT I **[30% Weightage]**

Generations of Computer (I-V), Block Diagram of a Computer, Functions of the Different Units: Input unit, Output unit, Memory unit, CPU (ALU+CU), Types of Number Systems.

UNIT II **[10% Weightage]**

Input & Output Devices:

Input Devices - Keyboard, Point and draw devices mouse, joystick, track ball, light pen, Data Scanning devices, image scanner, OCR, OMR, MICR, Bar code reader, card reader, Voice Recognition Device, Digitizers

Output Devices - Monitor, Printer, laser printer, dotmatrix printer, ink jet printer, Projector

UNIT III **[30% Weightage]**

Memories [Memory hierarchy]:

Registers [Types of Registers], Cache Memory, Primary Memory - i) RAM - How data is stored in a RAM, DRAM and SRAM, ii) ROM- ROM BIOS/ Firmware, Types of ROM

Secondary Memories - Hard disk (Structure of a hard disk, how data is stored in a hard disk, concept of tracks, sectors, clusters, cylinders), CD [data storage mechanism]

UNIT IV **[30% Weightage]**

Software:

System Software :Operating System (Functions of O/S, Types of O/S), Program Language Translators- i) Assembler ii) Compiler iii) Interpreter, Utility Programs, Communication Software.

Application Software : Software hierarchy and dependence between the different layers.

Computer Languages- Machine language, Assembly language, High level language

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-5	Generations of Computer (I-V), Block Diagram of a Computer, Functions of the Different Units: Input unit, Output unit, Memory unit, CPU (ALU+CU).
6-11	Types of Number Systems.
12-13	Input Devices: Keyboard, Point and draw devices mouse, joystick, track ball, light pen, Data Scanning devices, image scanner, OCR, OMR, MICR, Bar code reader, card reader, Voice Recognition Device, Digitizers
14-15	Output Devices: Monitor, Printer, laser printer, dotmatrix printer, ink jet printer, Projector
16-18	Memories [Memory hierarchy]: Registers [Types of Registers]
19-22	Cache Memory
23-24	Primary Memory - i) RAM - How data is stored in a RAM, DRAM and SRAM
25-26	ii) ROM- ROM BIOS/ Firmware, Types of ROM
27-29	Secondary Memories - Hard disk (Structure of a hard disk, how data is stored in a hard disk, concept of tracks, sectors, clusters, cylinders)
30-31	CD [data storage mechanism]
32-34	System Software- Operating System (Functions of O/S, Types of O/S), Program Language
35-38	Translators- i) Assembler ii) Compiler iii) Interpreter, Utility Programs, Communication Software
39-41	Application Software- Software hierarchy and dependence between the different layers-
42-45	Computer Languages- Machine language, Assembly language, High level language
15 Hours	*Tutorials*

Essential Readings:

1. Fundamentals of Computers, by V.Rajaraman, PHI.

2. Fundamentals of computers , E.Balagurusamy, TMH.
3. Computer Fundamentals by P.K. Sinha.
4. Computers, Larry long & Nancy long, Prentice Hall.
5. Computer Fundamentals by Anita Goel, Pearson Education India.

INTRODUCTION TO DATABASE SYSTEMS

Course Details			
Course Title: INTRODUCTION TO DATABASE SYSTEMS			
Course Code:	CSC82OE04404	**Credits**	4
L + T + P	3 + 1+ 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Course Type	Open Elective	**Nature of the Course**	Theory
Methods of Content Interaction	Lecture, Tutorials, self-study, Home Assignments, Class Tests		
Assessment and Evaluation	● 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) ● 70% - End Term External Examination (University Examination)		

Course Objectives

- To enable students, understand the need of database, its components and their functions and the stakeholders.
- To enable students, understand fundamental of Relational Model with details, on which most of the modern database software are based.
- To enable students, understand the process of normalization to mathematically evaluate your logical schema of the database, remove information access anomalies and minimize redundancy.
- To enable students, understand various integrity constraints that are imposed on databases to ensure consistency in databases.
- To enable students to understand fundamentals of the SQL, a standard query language that is used to fetch desired information from the database.

Course Learning outcomes

After completing the course, the students

- will be able to understand what is a database, what management functions it allows its users to perform.
- will be able to understand the functions of various components of a database management system
- will be able to refine the design of the database to minimize the redundancy and information access anomaly.
- They will be able to implement database and write queries to fetch desired information from the database.

Course Contents:

UNIT I **(20% Weightage)**

Introduction: Purpose of database systems, database language, transaction management, storage management, database administrator, database users, overall system structure, Classification of Database Management System, Three- Schema Architecture.

UNIT II **(25% Weightage)**

Relational Model: Structure of relational databases, Concept of Keys, relational algebra and extended relational-algebra operations.

Integrity Constraints: Domain constraints, referential integrity, and functional dependencies.

UNIT III **(25% Weightage)**

Relational Database Design: Pitfalls in relational database design, decomposition, normalization using functional: First Normal Form, Second Normal Form, Third Normal Form.

UNIT IV **(30% Weightage)**

SQL: Creating and modifying tables, dropping tables, inserting updating and modifying the data in a table, specifying integrity constraints like primary foreign key, check constraints, retrieving data from tables, aggregation operators, group by and having clause.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Purpose of database system, database language
3-3	Transaction management, storage management,
4-4	database administrator, database users
5-6	overall system structure
6-6	Classification of Database Management System,
7-7	Three- Schema Architecture
8-10	Relational Model, Structure of relational databases
11-12	Concept of Keys
13-16	relational algebra
17-20	extended relational-algebra operations
21-22	Integrity Constraints: Domain constraints
23-24	referential integrity
25-26	functional dependencies
27-27	Pitfalls in relational database design
28-29	decomposition, normalization using functional
30-33	First Normal Form, Second Normal Form, Third Normal Form
34-36	SQL: Creating and modifying tables, dropping tables
37-38	inserting updating and modifying the data in a table
39-40	specifying integrity constraints like primary foreign key, check constraints
41-43	retrieving data from tables
43-45	aggregation operators, group by and having clause
15 Hours	Tutorials

Essential Readings:

1. Database System Concepts, 6th edition, by A. Silberschatz, H. F. Korth, & S. Sudarshan, McGraw Hill.
2. Fundamental of Database Systems, by Elmasri, Navathe, Somayajulu, and Gupta, Pearson Education.
3. SQL The Complete Reference, 3rd Edition, by James Groff, Paul Weinberg, Andy Oppel, McGraw Hill Education, ISBN-13: 978-1259003882

Suggested Readings:

1. Learning MySQL, Seyed M.M. (Saied) Tahaghoghi, Hugh Williams, O'Reilly Media (November 24, 2006), ISBN-978-0596008642.
2. An Introduction to Database Systems, Bipin C Desai, Galgotia Publications New Delhi, ISBN-13: 978-8175157521
3. Head First SQL, Beighley Lynn, First edition, Shroff Publication, ISBN-13: 978-8184043686
4. MySQL Database Usage & Administration, by Vikram Vaswani, McGraw-Hill Company, ISBN-978-0-07-160550-2.