Annexure – I

CENTRAL UNIVERSITY OF SOUTH BIHAR

Master of Computer Science (MSCSC) Programme Syllabus

(Effective from Academic Session 2018-2019)

Department of Computer Science
SCHOOL OF MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

M.Sc. Computer Science
Core Courses Basket

OPERATING SYSTEMS

Course Details			
Course Title: OPERATING SYSTEMS			
Course Code	MSCSC1001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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

Prerequisites: Basic of Computer, Programming Concept,

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. **[5L]**

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.

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

[15L]

UNIT III

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

[8L]

UNIT IV

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

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

[12L]

UNIT VIII

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

[5L]

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*

Text Books:

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

References Books :

1. Operating Systems by Deitel, Deitel & Choffnes.
2. Modern Operating Systems by Tanenbaum Pearson Education
3. Operating System by Stallings Pearson Education.

DATA STRUCTURE AND ALGORITHMS

Course Details			
Course Title: DATA STRUCTURE AND ALGORITHMS			
Course Code	MSCSC1002C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- 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.

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*
• **Suggested References:** • 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 Algorithmsl 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	MSCSC1003C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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, 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, ATM, X.25 and Frame Relay.

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, 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, ATM, X.25 and Frame Relay.
15 Hours	*Tutorials*

- Suggested References:
- Computer Networking, by Kurose & Ross, Pearson Education
- Computer Network, A system approach; Larry L. Peterson & Bruce. S. Davie .the Morgan Kaufmann Series.
- Data Communications and Networks, by Forouzan, TMH
- Computer Networks, by Tanenbaum, Pearson Education
- Data & Computer Communication, by William Stallings, Pearson Education
- Networking, All-in-one Desk Reference, 10 Books in 1 by Doug lowe, Wiley

DATA STRUCTURE LAB

Course Details			
Course Title: DATA STRUCTURE LAB			
Course Code	MSCSC1004C04	**Credits**	4
L + T + P	0 + 0 + 4	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	120(P) Hours
Methods of Content Interaction	Practical, self-study, presentations by students. 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

- The objective of the lab is to make student to learn how to create and manipulate different linear and non-linear data structures using C.
- To develop skill of Practical implementation of Sorting.
- To develop skill of Practical implementation of Searching.
- To develop skill of Practical implementation of Tree and graph.
- To develop skill of computational understanding of different data structures.

Learning Outcomes

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

- Various data structures in deep.
- They would be comfortable with the pointers also.
- Implement practically different data structures according to need.
- Establish a connection between dry run and practically running the problem.
- Examine the goodness of a particular data structure by practically analyzing its properties.

Course Contents

UNIT I: Arrays and Stacks **(17% Weightage)**

Arrays: Creating Arrays, Insertion and deletion into array

Stack: Creating a Stack using Array, Push and Pop Operation.

UNIT II: Queue and Linked List **(25% Weightage)**

Queue: Creating a queue, Insertion and deletion in a queue.

Link List: Creating Link List, Insertion and deletion into a linked list, Circular linked list.

UNIT III: Searching and Sorting using Arrays **(25 % Weightage)**

- **Searching:** Linear Search, binary search
- **Sorting:** Bubble Sort, Insertion Sort, Selection Sort, Quick sort, Merging

UNIT IV: Tree **(16%Weightage)**

Tree: Creating binary tree. Traversing a binary binary tree, Insertion and deletion of a node into binary tree.

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

Creating a graph using adjacency list, inserting a node and edge into the graph, deletion of a node, edge from the graph. Traversing a graph using Depth-First-Search, Breadth-First-Search.

Practical cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-13	**Arrays:** Creating Arrays, Insertion and deletion into array
14-28	**Stack:** Creating a Stack using Array, Push and Pop Operation.
29-36	**Queue:** Creating a queue, Insertion and deletion in a queue.
37-52	**Link List:** Creating Link List, Insertion and deletion into a linked list, Circular linked list.
53-68	**Searching:** Linear Search, binary search.
69-88	**Sorting:** Bubble Sort, Insertion Sort, Selection Sort, Quick sort, Merging

89-100	**Tree:** Creating binary tree. Traversing a binary binary tree, Insertion and deletion of a node into binary tree.
101-120	Creating a graph using adjacency list, inserting a node and edge into the graph, deletion of a node, edge from the graph. Traversing a graph using Depth-First-Search, Breadth-First-Search.

- Suggested References:
- Data Structure Through C, by Yashavant P. Kanetkar, BPB Publications.
- Data Structures and Program Design in C, Robert Kruse, ClTondo, Pearson Education India, ISBN-8177584235, 9788177584233.
- Data Structures with C (Schaum's Outline Series) Seymour Lipschutz, TMH, ISBN- -978-0070701984
- Understanding Pointers in C by Yashavant P. Kanetkar BPB Publications.
- The C Programming Language, Brian W. Kernighan, Pearson Education; 2 edition (2015), ISBN-9332549443
- Data Structures and Algorithm Analysis in C, by Mark A. Weiss Pearson; 2 edition, ISBN-978-0201498400

DATABASE MANAGEMENT SYSTEMS

Course Details			
Course Title: DATABASE MANAGEMENT SYSTEMS			
Course Code:	MSCSC2001C04	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 30 (P) Hours
Methods of Content Interaction	Lecture, Tutorials, 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

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.

CSC: DATABASE MANAGEMENT SYSTEMS *Credit 4* *L-T-P : 3-0-1*

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

- Purpose of database systems
- View of data
- Data models, & interface
- Database language, transaction management, storage management, 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, embedded SQL and other SQL features.
- *Integrity Constraints:* Domain constraints, referential integrity, assertions, triggers and 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, transaction definition in SQL, Testing for serializability. Introduction of 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, & interface, database language
3-4	Transaction management, storage management, 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 of the database.
16-20	*Relational Languages (SQL):* Background, basic structure, set operations, aggregate functions, null values, nested sub-queries, joined relations, embedded SQL and other SQL features.
21-23	*Integrity Constraints:* Domain constraints, referential integrity, assertions, triggers and 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, transaction definition in SQL, Testing for serializability.
44-45	Introduction of Security and Integrity in database.
30 Hours	*Practical*

Text Book:

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.

Reference Books:

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 Details			
Course Title: OBJECT ORIENTED PROGRAMMING METHODOLOGY			
Course Code	MSCSC2002C04	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 30 (P) Hours
Methods of Content Interaction	Lecture, Practical, 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.

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.

Tutorial: 15 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	*Practical*

Text Books:

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.

Reference Books:

1. The C++ Programming language 3/e by BjarneStroustrup, Pearson Education.

P.K.Sinha

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 Details			
Course Title: SOFTWARE ENGINEERING			
Course Code	MSCSC2003C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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

- 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.

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.

Software Life Cycle Models: Waterfall, Prototyping, Evolutionary, Spiral models and their comparisons. **[8 L]**

UNIT II

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, S/W Configuration Management. **[7 L]**

UNIT III

Requirements Analysis and Specification: Requirement Gathering and Analysis, SRS, Formal System Development Techniques, Axiomatic and Algebraic Specification.

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

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. **[15 L]**

UNIT IV

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.

Computer Aided Software Engineering: CASE and its Scope, Environment, Support, Other Characteristics. **[10 L]**

UNIT V

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

Software Reuse: Basic Issues, Reuse Approach, Reuse at Organization Level. **[5 L]**

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, S/W Configuration Management.
16-22	**Requirements Analysis and Specification:** Requirement Gathering and Analysis, SRS, Formal System Development Techniques, Axiomatic and Algebraic Specification.
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. **Computer Aided Software Engineering:** CASE and its Scope, Environment, Support, Other Characteristics.
41-45	**Software Maintenance:** Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.

	Software Reuse: Basic Issues, Reuse Approach, Reuse at Organization Level
15 Hours	*Tutorials*

Text Books:

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

References Books :

1. Software Project Management From Concept to Deployment by Kieron Conway, dreamtech Press.
2. Software engineering, by Jawadekar, TMH

ARTIFICIAL INTELLIGENCE

Course Details			
Course Title: ARTIFICIAL INTELLIGENCE			
Course Code	MSCSC3001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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 (Each session of 1 Hour)	Unit/Topic/Sub-Topic

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*

- Suggested References:
- 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

- "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 Details			
Course Title: DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	MSCSC3002C04	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 30 (P) Hours
Methods of Content Interaction	Lecture, Practical, self-study, 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

- 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.

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 - radix sort, 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 - radix sort, 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.
30 Hours	*Practical*

Suggested References:

- T. H. Cormen, C.E. Leiserson and R.L.Rivest: Introduction to Algorithms, Prentice Hall of India, New Delhi, 1998.
- Aho, J. Hopcroft and J. Ullman; The Design and Analysis of Computer Algorithms, A.W.L, International Student Edition, Singapore, 1998.
- S. Baase: Computer Algorithms: Introduction to Design and Analysis, 2nd ed., Addison-Wesley, California, 1988.
- E. Horowitz and S. Sahni: Fundamental of Computer Algorithms, Galgotia Pub./Pitman,New Delhi/London, 1987/1978.
- K. Mehlhorn: Data Structures and Algorithms, Vol. 1 and Vol. 2, Springer-Verlag, Berlin, 1984.
- Borodin and I. Munro: The Computational Complexity of Algebraic and Numeric Problems, American Elsevier, New York, 1975.

DATA MINING

Course Details			
Course Title: DATA MINING			
Course Code	MSCSC3003C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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.

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*

Text Books:

1. Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, 2007
2. Data Mining – Concepts and Techniques - Jiawei Han and Micheline Kamber, 2nd Edition, Morgan Kaufmann, 2006.
3. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
4. Insight into Data Mining – Theory and Practice - K.P.Soman, Shyam Diwakar, V.Ajay, PHI

References Books:

1. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
2. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.

1st Semester Elective Basket (Within Deptt.)

DIGITAL LOGIC DESIGN

Course Details			
Course Title: DIGITAL LOGIC DESIGN			
Course Code	MSCSC1001E04	Credits	4
L + T + P	3 + 1 + 0	Course Duration	One Semester
Semester	Odd	Contact Hours	45 (L) + 15 (T) Hours
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.

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*
	Text Books :

	1. Digital Logic and Computer Design by M. Moris Mano, 4th Edition. 2. Digital Principles and Applications by Leach, Paul Malvino, 5th Edition. **References :** 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 Details			
Course Title: MODELING AND SIMULATION			
Course Code	MSCSC1002E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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*

Text Books:

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

Reference Books:

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 Details			
Course Title: STATISTICAL METHODS			
Course Code	MSCSC1003E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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 .

Prerequisites:

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*

Text Books:

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

References Books :

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

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INTRODUCTION TO MICROPROCESSORS

Course Details			
Course Title: INTRODUCTION TO MICROPROCESSORS			
Course Code	MSCSC1004E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

The objective of the course is:

- To acquaint the students to the architecture and instruction set of typical 8-bit microprocessor.
- It also deals with Assembly Language Programming being used in a macro-assembler.
- Techniques for Input-output and important programmable support chips used in microprocessor-based systems are discussed.

Learning Outcomes

After learning this course, students will be able:

- To understand the internal operations of a 8-bit microprocessor.
- Will be able to write assembly language programs to solve different problems.

Prerequisites:

One should have the idea of Digital logic systems, circuits and their operations.

UNIT I **(6% weightage)**

Introduction of Microcomputer System: CPU, I/O devices, clock, memory, bus architecture, tristate logic, address bus, data bus and control bus.

UNIT II **(20% weightage)**

Architecture of 8-bit Microprocessor: Intel 8085A microprocessor, Pin description and internal architecture.

UNIT III **(15% weightage)**

Operation and Control of Microprocessor: Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.

UNIT IV **(14% weightage)**

Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, Unspecified flags and instructions.

UNIT V **(20% weightage)**

Assembly Language Programming: Assembler directives, simple examples; Subroutines, parameter passing to subroutines.

UNIT VI **(15% weightage)**

Interfacing: Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure; Input/output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer.

UNIT VII **(6% weightage)**

Interrupts: Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

UNIT VIII **(4% weightage)**

Programmable Peripheral Interface: Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming ;ADC and DAC chips and their interfacing.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
1-6	Introduction of Microcomputer System: CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus.
7-11	Architecture of 8-bit Microprocessor: Intel 8085A microprocessor, Pin description and internal architecture.
12-14	Operation and Control of Microprocessor: Timing and control unit, op-code fetch machine cycle.
15-20	Memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.
21-26	Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, Unspecified flags and instructions.
27-33	Assembly Language Programming: Assembler directives, simple examples; Subroutines, parameter passing to subroutines.
34-36	Interfacing: Interfacing of memory chips, address allocation technique and decoding
37-38	Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure;
39-40	Input/Output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer.
41-43	Interrupts: Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

44-45	Programmable Peripheral Interface: Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming ;ADC and DAC chips and their interfacing.
15 Hours	*Tutorials*

Text Books:

1. Gaonkar R.S.,"Microprocessor Architecture,Programming and Applications", 5th Ed., Penram International, 2007.

References Books :

3. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.
4. Stewart J."Microprocessor Systems- Hardware,Software and Programming", Prentice Hall International Edition,1990
5. Short K. L.,"Microprocessors and Programmed Logic",.2nd Ed.,Pearson Education, 2008.

2nd Semester Elective Basket (SWAYAM/Within Deptt.)

COMPUTER ORGANIZATION

Course Details			
Course Title: COMPUTER ORGANIZATION			
Course Code	MSCSC2001E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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*

Text Books:

3. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw-Hill, 2002.
4. M. Morris Mano, "Computer System architecture".

References Books :

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

NATURAL LANGUAGE PROCESSING

Course Details			
Course Title: NATURAL LANGUAGE PROCESSING			
Course Code	MSCSC2002E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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

At the end of this course:

- Students should have a sound knowledge of the methods used in different areas of natural language processing.
- Students should also be able to use this knowledge to implement simple natural language processing algorithms and applications.

Learning Outcomes

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

- Understand the application and analysis of NLP systems.
- Synthesis and evaluation: Compare and contrast approaches to natural language processing, Discuss the limitations and promise of NLP.

Prerequisites: Students should have knowledge of Algorithms, Theory of Computation etc.

UNIT I

[25% Weightage]

Shallow Processing – Morphology fundamentals – Finite State Machine based Morphology – Part of Speech Tagging and Named Entity tagging – Machine learning algorithms for NLP

UNIT II

[12% Weightage]

Parsing – Classical Approaches: Top-Down, Bottom-UP and Hybrid Methods – Chart Parsing, Early Parsing – Statistical Approach: Probabilistic Parsing, Tree Bank Corpora

UNIT III

[10% Weightage]

Lexical Semantics and/or Discourse Processing – Lexicons, Word Sense Disambiguation – Coreferences

UNIT IV

[10% Weightage]

Information Extraction and Text Classification – Approaches of IE and Applications. Anaphora Resolution in biomedical texts – text classification approach.

UNIT V

[15% Weightage]

Applications – Machine Translation – Information Retrieval (cross-lingual) – Summarization – Question Answering

UNIT VI

[28% Weightage]

Indian Language Computing – Named Entity Recognition – Part of Speech Tagging – Machine Translation - Cross lingual information access

Content Interaction Plan:

Lecture cum Discussion (Each session	Unit/Topic/Sub-Topic

of 1 Hour)	
1	**Shallow Processing** – Morphology fundamentals
2-4	Finite State Machine based Morphology
5-10	Part of Speech Tagging and Named Entity tagging – Machine learning algorithms for NLP
11-14	**Parsing** – Classical Approaches: Top-Down, Bottom-UP and Hybrid Methods – Chart Parsing, Early Parsing – Statistical Approach: Probabilistic Parsing, Tree Bank Corpora
15-16	**Lexical Semantics and/or Discourse Processing** – Lexicons, Word Sense Disambiguation – Coreferences
17-20	Approaches of IE and Applications
21-26	**Information Extraction and Text Classification** – Anaphora Resolution in biomedical texts – text classification approach.
27-31	**Applications** – Machine Translation
32-37	Information Retrieval (cross-lingual) – Summarization – Question Answering
38-42	**Indian Language Computing** – Named Entity Recognition
43-45	Part of Speech Tagging – Machine Translation - Cross lingual information access
15 Hours	*Tutorials*

Text book:

1. Speech and Language Processing, by D. Jurafsky and R. Martin (2nd edition)
2. Natural Language Understanding : James Allan

Reference Books:

1. Foundations of Statistical NLP: Manning and Schutze
2. NLP a Panninian Perspective: Bharati, Chaitanya and Sangal
3. Statistical NLP :Charniak

DISTRIBUTED SYSTEM

Course Details			
Course Title: DISTRIBUTED SYSTEM			
Course Code	MSCSC2003E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	45 (L) + 15 (T) Hours
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 learn and analyze how a set of connected computers can form a functional, usable and high-performance distributed system.
- 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.

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. **[6L]**

Message Passing: Introduction, Desirable features, Issues in IPC by message passing, synchronization, Buffering, Multi datagram messages, encoding and decoding message data.**[6L]**

UNIT II

Clock Synchronization and Mutual Exclusion : Introduction, Clock synchronization, Mutual exclusion in Distributed system, Deadlocks, Deadlocks in Distributed systems. **[6L]**

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. **[5L]**

UNIT III

Distributed Shared Memory: Introduction, Architecture of DSM Systems Design and implementation, granularly, structure of shared memory space Consistency models, replacement strategy, Thrashing. **[6L]**

Resource Management: Desirable feature, Task assignment approach, Load-balancing approach, Load-sharing approach. **[5L]**

UNIT IV

Process Management: Introduction, Process Migration, Threads. **[5L]**

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. **[6L]**

Content Interaction Plan

Lecture cum Discussion	Unit/Topic/Sub-Topic

(Each session of 1 Hour)	
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 system
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*

Text Books:

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

References Books :

1. Modern Operating Systems – A. S. Tanenbaum (PHI)

2. Modern Operating Systems – Singhal

COMPUTER GRAPHICS

Course Details			
Course Title: COMPUTER GRAPHICS			
Course Code	MSCSC2004E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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*
	Text Books : 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 **Reference Books:** 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 TECHNOLOGIES

Course Details			
Course Title: INTERNET TECHNOLOGIES			
Course Code:	MSCSC2005E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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)**

Evolution of 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 and clickable maps, JAVA applets, JAVA script, JAVA servlets, Perl. DHTML, XML

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

E-Commerce and security issues including symmetric and asymmetric key, encryption and digital signature, authentication

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

Emerging trends in Internet Technologies, Internet telephony, virtual reality over the web, etc. Intranet and extranet, firewall design issues.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-1	Evolution of 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
18-19	Designing web pages: HTML, forms
20-21	CGI scripts and clickable maps
22-23	JAVA applets
24-26	JAVA script
27-27	JAVA servlets
28-30	Perl
31-31	DHTML
32-33	XML
34-35	E-Commerce and security issues including symmetric and asymmetric key

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36-37	encryption and digital signature
38-38	authentication
39-39	Emerging trends in Internet Technologies
40-41	Internet telephony
42-43	virtual reality over the web
44-44	Intranet and extranet
45-45	firewall design issues
15 Hours	Tutorials

Text Books :

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

Reference Books:

1. Horstmann, "Core Java", Addison Wesley.
2. Herbert Schildt, "The Complete Reference:Java", TMH.
3. Hans Bergsten, "Java Server Pages", SPD O'Reilly

MOBILE NETWORK SYSTEMS

Course Details			
Course Title: MOBILE NETWORK SYSTEMS			
Course Code:	MSCSC2006E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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 uniques 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

Text Books :

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

References Books:

1. Upadhyaya, "Mobile Computing", Springer .
2. Charles Perkins, Ad hoc Networks, Addison Wesley.

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WIRELESS SENSOR NETWORK

Course Details			
Course Title: WIRELESS SENSOR NETWORK			
Course Code:	MSCSC2007E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 gathers, process, aggregates and transmit the data.
- To introduce students about security issues and challenges unique to sensor networks.

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

Text Books:

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

Reference Books :

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 Network Designs, John Wiley & Sons Ltd., 2003.
5. Nirupama Bulusu and Sanjay Jha, Wireless Sensor Networks : A systems perspective, Artech House, August 2005.

NEXT GENERATION NETWORK

Course Details			
Course Title: NEXT GENERATION NETWORK			
Course Code:	MSCSC2008E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 network technologies, their advantages, disadvantages and the services they offers
- To introduce students about their design respective issues and challenges

Learning outcomes

After the course the students will be able to:

- Know about the next generation network 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 network 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

Text Books:

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

References Books :

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

COMPILER DESIGN

Course Details			
Course Title: COMPILER DESIGN			
Course Code	MSCSC2009E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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.

P.K. Singh

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*

Text books:

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

Reference Books:

1. Holub, Compiler Design in C, PHI.

Modern Compiler Implementation in C by Appel

3rd Semester Elective Basket (Within Deptt.)

BIG DATA

Course Details			
Course Title: BIG DATA			
Course Code	MSCSC3001E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- 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

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 **[5L]**

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 **[10L]**

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 **[10L]**

UNIT IV

CLASSIFICATION OF ANALYTICS

Predictive analytics – Descriptive analytics – Survival analytics – Social network analytics – Example applications **[8L]**

UNIT V

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

HADOOP AND MAPREDUCE FRAMEWORK

The Hadoop Framework – History of Hadoop –Advantages and Disadvantages of Hadoop – HDFS architecture– Features of HDFS– Map Reduce architecture **[12L]**

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***

Text Books:

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

References Books :

1. Designing Data Visualization by Noab Iliinsky, Julie Steele O'REILLY publication
2. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J , Martin Flower PEARSON publication
3. Big Data and Analytics by Seema Acharya and Subhasini Chellappan Wiley India
4. Effective Data Visualization From Design Fundamentals to Big Data Techniques by Jeferry Heer O'Reilly

MACHINE LEARNING

Course Details			
Course Title: MACHINE LEARNING			
Course Code	MSCSC3002E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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*

Text Books:

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

References Books :

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

ADVANCED COMPUTER NETWORKS

Course Details			
Course Title: ADVANCED COMPUTER NETWORKS			
Course Code:	MSCSC3003E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, Lab 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 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

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)**

Introduction: 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*

Text Books :

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.

References Books :

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.

CRYPTOGRAPHY & NETWORK SECURITY

Course Details			
Course Title: CRYPTOGRAPHY & NETWORK SECURITY			
Course Code:	MSCSC3004E04	**Credits**	4
L + T + P	3 + 1 +0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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), Modern Block Cipher (AES).

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

UNIT 3 **(40% Weightage)**

Stream Ciphers and Pseudorandomness : Stream Ciphers, Pseudorandom functions, Hash Stream Ciphers and Pseudorandomness : 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)
18-18	Overview on S-Box Design Principles
19-20	Modes of operation of Block Ciphers
21-22	Linear Cryptanalysis, Differential Cryptanalysis
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*

Text Book:

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.
4. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
5. Hoffstein, Pipher, Silverman, "An Introduction to Mathematical Cryptography", Springer.

References Books :

1. J.Daemen, V. Rijmen,"The Design of Rijndael ", Springer.
2. A. Joux, "Algorithmic Cryptanalysis", CRC Press.
3. C. Boyd, A. Mathuria, "Protocols for Authentication and Key Establishment", Springer.
4. Matt Bishop, "Computer Security", Pearson Education.

NATURE INSPIRED COMPUTING METHODS

Course Details			
Course Title: NATURE INSPIRED COMPUTING METHODS			
Course Code	MSCSC3005E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- This course will teach students how computational processes can be derived from natural models.
- We will focus on major nature-inspired algorithmic approaches.

Learning Outcomes

You will learn:

- How most of the nature-inspired algorithms operates.
- How to select and apply suitable nature-inspired algorithms to solve computational problems

Course Contents

UNIT–I **[20% Weightage]**

Natural to Artificial Systems – Biological Inspirations in problem solving – Behavior of Social Insects: Foraging - Division of Labor - Task Allocation – Cemetery Organization and Brood Sorting – Nest Building - Cooperative transport.

UNIT–II **[15% Weightage]**

Ant Colony Optimization: Ant Behavior - Towards Artificial Ants - Ant Colony Optimization – Problem solving using ACO - Extensions of Ant Systems - Applications.

UNIT–III **[20% Weightage]**

Swarm Intelligence: Introduction to Swarm Intelligence – Working of Swarm Intelligence - Optimization – Particle Swarms - Applications

UNIT-IV **[25% Weightage]**

Introduction to Genetic Algorithms - population initialization - choosing a fitness function - selection - crossover - mutation - reinsertion - applications of genetic algorithms - evolutionary algorithms

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

Other Biological Computing Methods - Immune System Algorithms - Cellular Automata - Lindenmeyer Systems - Artificial Neural Networks - Simulated Annealing

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-5	Natural to Artificial Systems – Biological Inspirations in problem solving – Behavior of Social Insects: Foraging - Division of Labor
6-11	Task Allocation – Cemetery Organization and Brood Sorting – Nest Building - Cooperative transport.
12-17	Ant Colony Optimization: Ant Behavior - Towards Artificial Ants - Ant Colony Optimization
18-23	Problem solving using ACO - Extensions of Ant Systems - Applications.
24-29	Swarm Intelligence: Introduction to Swarm Intelligence
30-34	Working of Swarm Intelligence - Optimization – Particle Swarms - Applications
35-40	Introduction to Genetic Algorithms - population initialization - choosing a fitness function - selection - crossover - mutation - reinsertion - applications

	of genetic algorithms - evolutionary algorithms
41-45	Other Biological Computing Methods - Immune System Algorithms - Cellular Automata - Lindenmeyer Systems - Artificial Neural Networks - Simulated Annealing
15 Hours	*Tutorials*
	Text Books 1. Stephan Olariu and Albert Zomaya, Hanbook of Bioinspired Algorithms and Applications, Chapman and Hall, 2006 2. Marco Dorigo, Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004. 3. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems" , Oxford University press, 2000. 4. Mitchell, Melanie, Introduction to genetic algorithms, ISBN: 0262133164, MIT Press, 1996 5. Nunes de Castro, Leandro, *Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications*, Chapman & Hall, 2006 **Reference Books:** 1. Nunes de Castro, Leandro and Fernando J. Von Zuben, *Recent Developments in Biologically Inspired Computing,* MIT Press, 2005
	2. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence, MIT Press, 2008 3. Camazine, Scott et al, Self-organization in biological systems, ISBN: 9780691116242, Princeton University Press, 2001 4. Nancy Forbes, Imitation of Life - How Biology Is Inspiring Computing, , MIT Press, 2004. 5. Christian Blum, Daniel Merkle (Eds.),"Swarm Intelligence: Introduction and Applications", Springer Verlag, 2008. 6. Leandro N De Castro, Fernando J Von Zuben,"Recent Developments in Biologically Inspired Computing", Idea Group Inc., 2005.

SOFTWARE TESTING

Course Details			
Course Title: SOFTWARE TESTING			
Course Code	MSCSC3006E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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, A Software Testing Strategy for Object-Oriented Architectures, Criteria for Completion of Testing. **[8L]**

UNIT-II

Strategic Issues: Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Validation Testing, Validation Test Criteria, Configuration Review, Alpha and Beta Testing

System Testing: Recovery Testing, Security Testing, Stress Testing, Performance Testing. **[7L]**

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

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

Object-Oriented Testing Methods: The Test Case Design Implications of OO Concepts, Applicability of Conventional Test Case Design Methods, Fault-Based Testing, Test Cases and Class Hierarchy, Scenario-Based Testing, Testing Surface Structure and Deep Structure **[15L]**

UNIT-IV

Testing Methods Applicable at the Class Level: Random Testing for OO Classes, Partition Testing at the Class Level

Inter Class Test Case Design : Multiple Class Testing, Tests Derived From Behaviour Models , Testing for Specialized Environments, Architectures, and Applications **[10L]**

UNIT-V

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. **[5L]**

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
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, A Software Testing Strategy for Object-Oriented Architectures, Criteria for Completion of Testing
9-12	**Strategic Issues:** Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Validation Testing, Validation Test Criteria, Configuration Review, Alpha and Beta Testing
13-15	**System Testing:** Recovery Testing, Security Testing, Stress Testing, Performance Testing
16-17	**Testing Tactics:** Software Testing Fundamental , Black-Box and White-Box Testing
18-19	**Basis Path Testing :** Flow Graph Notation, Independent Program Paths, Deriving Test Cases, Graph Matrices
20-22	**Control Structure Testing :** Condition Testing, Data Flow Testing, Loop Testing
23-25	**Black-Box Testing:** Graph-Based Testing Methods, Equivalence Partitioning, Boundary Value Analysis, Orthogonal Array Testing
26-30	**Object-Oriented Testing Methods:** The Test Case Design Implications of OO Concepts, Applicability of Conventional Test Case Design Methods, Fault-Based Testing, Test Cases and Class Hierarchy, Scenario-Based Testing, Testing Surface Structure and Deep Structure
31-35	**Testing Methods Applicable at the Class Level:** Random Testing for OO Classes, Partition Testing at the Class Level
36-40	**Inter Class Test Case Design :** Multiple Class Testing, Tests Derived From Behaviour Models , Testing for Specialized Environments, Architectures, and Applications
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*

Text Books:

1. Software Testing (2nd Edition) by Ron Patton.
2. Software Engineering A Practitioner's Approach by Pressman , MGH

References Books :

1. Software Engineering, by Sommerville, Pearson education.
2. Fundamentals of Software Engineering by Rajib Mall, PHI

SOFTWARE PROJECT MANAGEMENT

Course Details			
Course Title: SOFTWARE PROJECT MANAGEMENT			
Course Code	MSCSC3007E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- Understand the fundamental principles of Software Project management
- Also knows the responsibilities of project manager and how to handle these.
- Be familiar with the different methods and techniques used for project management.
- Student understand the issues and challenges faced while doing the Software project Management
- Also be able to understand why majority of the software projects fails and how that failure probability can be reduced effectively.

Learning Outcomes

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

- Students will be able to do the Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques
- Design Requirement Specifications
- Design Formal Approaches to SQA, Statistical Software Quality and Assurance
- Utilize technology tools for communication, collaboration, information management, and decision support.
- Implement general business concepts, practices, and tools to facilitate project success.

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- Adapt project management practices to meet the needs of stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).
- Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

Prerequisites: Basic of Computer Science and Basic of Software Engg. Concept

Course Contents

UNIT I : Introduction

SPM Basic Concepts, Project Management, Project Management: Core Functions, support Functions, Project Integration Management, Relationships: Knowledge Areas Versus Projects.

Software Development Process Management

Software Development Process Management, Management of Software workflows, Evaluation of Workflow |Process, Workflow process Templates, Integration of Software Engineering Management and Project Life Cycle **[10 L]**

UNIT II : Requirements Management

Why Requirements Management, Analysis of the Problem, User Analysis and Identifying User Needs, Requirement Specifications, Requirement Assurance Through Right System, Managing Requirements Change.

Project Scheduling & Estimation

Project Scheduling, Defining a Task set for the software project, Defining a task network, Scheduling, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Estimation for object-oriented Projects, Specialized Estimation Techniques, The make/Buy decision. **[12 L]**

UNIT III: Risk Management

Reactive vs. Proactive Risk strategies, Software Risk, Risk Identification, Risk Projection, Risk Refinements, Risk Mitigation, Monitoring, Risk Management, The RMMM plan.

[8L]

UNIT IV: Quality Management

Quality, Quality Control, Quality Assurance, Cost of Quality, Software Quality Assurance : Background Issues, SQA Activities, Software Technical Reviews : The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, Sample-Driven Reviews, Formal Approaches to SQA, Statistical Software Quality, Assurance, A Generic Example, Six Sigma for Software Engineering, Software Reliability, Measures of Reliability and Availability, software Safety, The ISQ Plan. **[10L]**

UNIT V: Change Management

Software Configuration Management, The SCM Repository, The SCM Process, Configuration management for web engineering. **[5L]**

Tutorial : 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-3	SPM Basic Concepts, Project Management, Project Management: Core Functions, support Functions, Project Integration Management, Relationships: Knowledge Areas Versus Projects.
4-10	**Software Development Process Management** Software Development Process Management, Management of Software workflows, Evaluation of Workflow Process, Workflow process Templates, Integration of Software Engineering Management and Project Life Cycle
11-14	Why Requirements Management, Analysis of the Problem, User Analysis and Identifying User Needs, Requirement Specifications, Requirement Assurance Through Right System, Managing Requirements Change.
15-22	**Project Scheduling & Estimation** Project Scheduling, Defining a Task set for the software project, Defining a task network, Scheduling, Software Project Estimation,

	Decomposition Techniques, Empirical Estimation Models, Estimation for object-oriented Projects, Specialized Estimation Techniques, The make/Buy decision.
23-30	Reactive vs. Proactive Risk strategies, Software Risk, Risk Identification, Risk Projection, Risk Refinements, Risk Mitigation, Monitoring, Risk Management, The RMMM plan
31-35	Quality, Quality Control, Quality Assurance, Cost of Quality, Software Quality Assurance : Background Issues, SQA Activities, Software Technical Reviews : The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, Sample-Driven Reviews,
36-40	Formal Approaches to SQA, Statistical Software Quality, Assurance, A Generic Example, Six Sigma for Software Engineering, Software Reliability, Measures of Reliability and Availability, software Safety, The ISQ Plan.
41-45	Software Configuration Management, The SCM Repository, The SCM Process, Configuration management for web engineering.
15 Hours	***Tutorials***

Text Books:

1. Software Project Management From Concept to Deployment by Kieron Conway, dreamtech Press
2. Software Engineering, by Jawadekar, TMH
3. Software Engineering A Practitioner's Approach by Pressman , MGH

References Books :

1. Software Engineering, by Sommerville, Pearson education.
2. Fundamentals of Software Engineering by Rajib Mall, PHI
3. Software Engineering by James F. Peters, Wiley

SOFT COMPUTING

Course Details			
Course Title: SOFT COMPUTING			
Course Code	MSCSC3008E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

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*
	Text Books: 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 **Reference Books:** 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, 3rd ed, Wiley India

DIGITAL IMAGE PROCESSING

Course Details			
Course Title: DIGITAL IMAGE PROCESSING			
Course Code	MSCSC3009E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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: **(15% Weightage)**

Introduction to digital image processing, Gray scale and Colour images, Basics of MATLAB, Digital image representation: Coordinate Convention, Images as matrices, classes and image types, sampling and quantization.

UNIT II: Spatial Domain and Frequency domain Filtering: **(25% 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,

UNIT III: Wavelets and applications **(25%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 **(20% Weightage)**

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

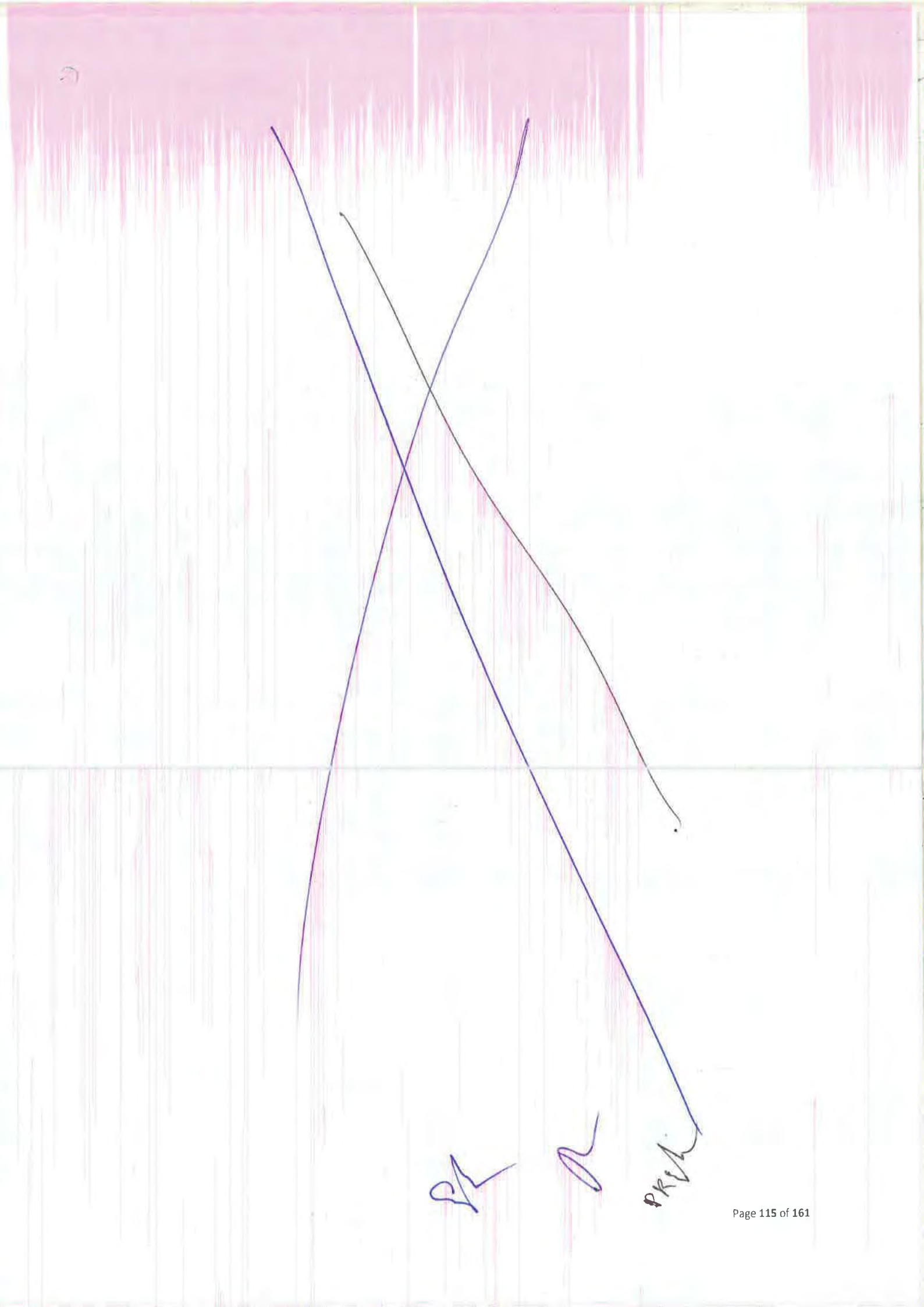
Morphological Image Processing: Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
1-4	Introduction to digital image processing, Gray scale and Colour images, Basics of MATLAB,
5-7	Digital image representation: Coordinate Convention, Images as matrices,

	classes and image types, sampling and quantization.
8-12	**Spatial Domain Filtering:** Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters.
13-17	**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.
18-22	**Introduction to Wavelets:** Introduction, admissibility criteria, scaling and wavelet function, Multiresolution analysis, wavelet transform: continuous wavelet transform, discrete wavelet transform,
23-28	**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.
29-33	Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Run length Coding,
34-39	Discrete Cosine Transform based image compression, Discrete Wavelet Transform based image compression.
	Performance Criterion:- Mean Square Error, Peak Signal to noise ratio for images
40-45	**Morphological Image Processing:** Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components
15 Hours	*Tutorials*

- Suggested References:
- Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.
- Fundamentals of Digital Image Processing By Anil K Jain.
- 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.



Skill Based / Self-Study Courses (Non-Credit)

COMMUNICATION SKILLS

Course Details			
Course Title: COMMUNICATION SKILLS			
Course Code	MSCSC3001S00	**Credits**	Non-Credit
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- How communication style influences how we are perceived by others.
- The factors governing good communication.
- How good communication skills can be developed.
- How good communication skills are a critical building block to both personal and business success.
- How to use effective communication skills in your business.
- The need to modify communication depending on business situation and circumstances.

Learning Outcomes

- Upon completion of the course, students are expected to be able to demonstrate a good understanding of:
- effective business writing
- effective business communications
- research approaches and information collection
- effective interpersonal communications

Course Contents:

UNIT I **[20% Weightage]**

Communication – Meaning – Objective and scope – Methods of communication – Types – Barriers – Principles of communication – communication process.

UNIT II **[25% Weightage]**

Layout of a letter – Business Inquires and Replies – Quotations – Order – Execution of orders – Cancellation of orders – claims – Adjustments and settlement of accounts – Sales letters – Circular letters.

UNIT III **[15% Weightage]**

Collection letters – Applications letter – Import Export correspondence – Bank Correspondence – Insurance correspondences.

UNIT IV **[20% Weightage]**

Reporting writing – Reports by Individual – committees – Annual Reports – Press report – Speeches – Preparation of Agenda – Minutes.

UNIT V **[20% Weightage]**

Internal communication : Short speeches – Memo – Circulars – Notices – Explanation to superiors. Modern means of communication: Intercom – Telex – Fax – Tele Conference – Internet – Email.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-5	Communication – Meaning – Objective and scope – Methods of communication – Types
6-10	Barriers – Principles of communication – communication process.
11-15	Layout of a letter – Business Inquires and Replies – Quotations
16-18	Order – Execution of orders – Cancellation of orders– claims

19-21	Adjustments and settlement of accounts – Sales letters – Circular letters.
22-27	Collection letters – Applications letter – Import Export correspondence
28-30	Bank Correspondence – Insurance correspondences.
31-33	Reporting writing – Reports by Individual – committees
34-36	Annual Reports – Press report
37-38	Speeches – Preparation of Agenda – Minutes.
39-42	Internal communication : Short speeches – Memo – Circulars – Notices – Explanation to superiors.
43-45	Modern means of communication: Intercom – Telex – Fax – Tele Conference – Internet – Email.
15 Hours	*Tutorials*
	Text Books : **1.** Essentials of Business Communication - Rajendra Paul & J.S. Korlahalli **2.** Effective Business English & Correspondences - M.S Ramesh & Patsan Shetty **3.** Business Correspondence and Office Management -R.S. Pilai & Bhagavathy **Reference Books:** 1. Business Communication - R.C. Sharma, Krishnamohan 2. Effective Letters in Business Law - Shurter

LATEX

Course Details			
Course Title: LATEX			
Course Code:	MSCSC3002S00	**Credits**	Non-Credit
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (P) Hours
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

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.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	**Unit/Topic/Sub-Topic**
1-2	Installation of the software LaTeX
3-3	Understanding Latex compilation.
4-4	Latex features
5-6	General syntax of a document in latex
7-10	Latex editors
10-12	Formatting the text, defining color for text, fonts
12-13	Sections and paragraphs
14-15	Inserting mathematical symbols
16-18	Writing equations.
19-20	Creating Matrices and Array
20-22	Tables in Latex
23-25	Inserting images, animation and videos
26-26	Creating lists
27-27	Common latex packages.
28-28	Latex Page Layout
29-29	Sections and subsections,

30-31	Equation references, References and citation in latex
32-32	Bibliography database
33-33	Writing Resume, question paper,
34-35	Articles/research papers
36-38	Thesis report
39-45	Creating presentation using beamer
15 Hours	Lab Work

Text Book:

1. LaTeX Beginner's Guide, Stefan Kottwitz, ISBN 13-97818471998 67, Packt Publishing Limited.
2. Latex: A Document Preparation System, 2/E, Lamport. Pearson Education India, ISBN 8177584146, 9788177584141

Reference Books:

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/

SOCKET PROGRAMMING USING PYTHON

Course Details			
Course Title: SOCKET PROGRAMMING USING PYTHON			
Course Code:	MSCSC3003S00	**Credits**	Non-Credit
L + T + P	0 + 0 + 2	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	15 (P) + 15 (L) Hours
Methods of Content Interaction	Lecture, Tutorials, self-study, Home 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 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

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 Contents:

UNIT I **(50% Weightage)**

Introduction to Socket: Client Server Architecture, Concept of Socket, vocabulary of sockets, socket families 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 families 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

P.K.S

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.
15 Hours	Lab

Text Books:

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.

Reference Books:

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

Elective Courses Basket For School

1st Semester Elective Basket Open for School

PROGRAMMING IN 'C'

Course Details			
Course Title: PROGRAMMING IN 'C'			
Course Code	MSCSC1051E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 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

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)**

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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*

- Suggested References:
- 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.

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INTRODUCTION TO IT

Course Details			
Course Title: INTRODUCTION TO IT			
Course Code	MSCSC1052E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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

- Understand the basics of computer organization structure and operation of computers.
- Expose different ways of communicating with I/O devices and standard I/O interfaces.
- Understand the concept of memory systems.
- Understand the concept of arithmetic and logical operations.
- To learn the fundamentals of Operating Systems.

Learning Outcomes

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

- Learn basic about Computer
- Learn about Number system
- Know basic about Memory system
- To Know about database
- To Know about internet and network

Prerequisites: No

Course Contents

UNIT 1

Computer Basics- Introduction, Evolution of Computers, Generations of Computers, Classification of Computers, The Computer system, Applications of Computers.

Computer organization and Architecture- Introduction, Central Processing Unit, Types of Number Systems.

Computer Memory and Storage- Introduction, Memory Hierarchy. Input Output Media- Introduction. **[10L]**

UNIT 2

Computer Programming and Languages- Introduction, Algorithm, Programming Paradigms, characteristics of a good program, programming Languages, generations of programming Languages, Features of a Good Programming Language.

Operating System- Introduction, Operating System Definition, Evolution of Operating System, Types of Operating Systems.

Database Fundamentals- Introduction, database definition.

[10L]

UNIT 3

Information Technology Basics- Introduction, Information, Technology, Information Technology, Present scenario, Role of Information Technology, Information Technology and the Internet

Multimedia:- Introduction, Multimedia- definition, Multimedia Applications.

[10L]

UNIT 4

Computer Networks- Computer Network, Network Topologies, Network Devices

Internet- - Introduction, Evolution of Internet, Basic Internet Terms, and Getting connected to the Internet, Internet Applications

Internet Tools- Introduction, Web Browser, Browsing Internet using Internet Explorer, E-mail Address Structure, Search engines

[10L]

UNIT 5

Current and Future Trends in IT- Introduction, Electronic commerce, Electronic data interchange, Smart card, internet protocol television, Blogging, Radio frequency identification, Imminent Technologies.

[5L]

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
1-3	**Computer Basics-** Introduction, Evolution of Computers, Generations of Computers, Classification of Computers, The Computer system, Applications of Computers.
4-7	**Computer organization and Architecture-** Introduction, Central Processing Unit, Types of Number Systems.
8-10	**Computer Memory and Storage-** Introduction, Memory Hierarchy, Input Output Media- Introduction.
11-13	**Computer Programming and Languages-** Introduction, Algorithm, Programming Paradigms, characteristics of a good program, programming Languages, generations of programming Languages, Features of a Good Programming Language.
14-17	**Operating System-** Introduction, Operating System Definition, Evolution of Operating System, Types of Operating Systems.
18-20	**Database Fundamentals-** Introduction, database definition.
21-35	**Information Technology Basics-** Introduction, Information, Technology, Information Technology, Present scenario, Role of Information Technology, Information Technology and the Internet
26-30	**Multimedia:-** Introduction, Multimedia- definition, Multimedia Applications.
31-33	**Computer Networks-** Computer Network, Network Topologies, Network Devices
34-36	**Internet-** - Introduction, Evolution of Internet, Basic Internet Terms, and Getting connected to the Internet, Internet Applications
37-40	**Internet Tools-** Introduction, Web Browser, Browsing Internet using Internet Explorer, E-mail Address Structure, Search engines
41-45	**Current and Future Trends in IT-** Introduction, Electronic commerce, Electronic data interchange, Smart card, internet protocol television, Blogging, Radio frequency identification, Imminent Technologies.
15 Hours	*Tutorials*

Text Books:

1. Introduction to Information Technology-ITL Education solutions limited, PEARSON.
2. Fundamentals of Information Technology, Second edition, Alexis Leon, Mathews Leon, (Leon VIKAS)

References Books :

1. Fundamentals of Computers, by V.Rajaraman, PHI.
2. Fundamentals of computers , E.Balagurusamy, TMH.

FUNDAMENTALS OF COMPUTERS

Course Details			
Course Title:	**FUNDAMENTALS OF COMPUTERS**		
Course Code	MSCSC1053E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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 will understand the concept of fundamentals of Computer, Assembly language, high level language
- Will give the idea of compiler, assembler and operating systems

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

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), Floppy [data storage mechanism], 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-

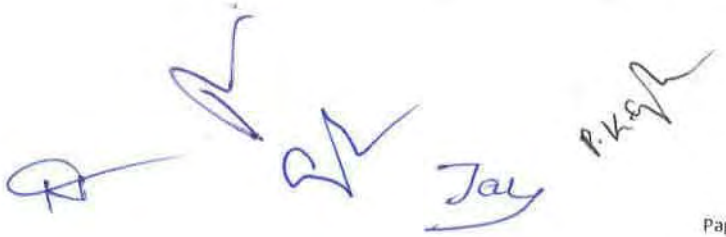
Software hierarchy and dependence between the different layers-

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	Floppy [data storage mechanism], 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*
	Text Books: 1. Fundamentals of Computers, by V.Rajaraman, PHI. 2. Fundamentals of computers , E.Balagurusamy, TMH. **Reference Books:**
	1. Computer Fundamentals by P.K. Sinha. 2. Computers, Larry long & Nancy long, Prentice Hall. 3. Computer Fundamentals by Anita Goel, Pearson Education India.



INTRODUCTION TO DATA STRUCTURE AND ALGORITHMS

Course Details			
Course Title: INTRODUCTION TO DATA STRUCTURE AND ALGORITHMS			
Course Code	MSCSC1054E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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*

- Suggested References:
  - 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 Algorithmsl 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.

2ND Semester Elective Basket Open for School

PROGRAMMING IN C++

Course Details			
Course Title: PROGRAMMING IN C++			
Course Code	MSCSC2051E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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

- Learning object oriented programming concepts.
- Develop problem solving skills using object oriented programming concept.
- Ultimate goal is to make a good programmer that uses object oriented approach.

Learning Outcomes

After going through this course a student should:

- Be able to write program using classes and objects, operator overloading, dynamic memory allocation, inheritance and polymorphism 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 **(20% weightage)**

C++ overview: C++ characteristics, object-oriented terminology, polymorphism, object-oriented paradigm, abstract data types.

UNIT II **(25% weightage)**

Functions and variables: functions: declaration and definition, variables: definition, declaration, and scope, variables: dynamic creation and derived data, arrays and strings in c++, qualifiers.

Classes in c++: defining classes in c++, classes and encapsulation, member functions, instantiating and using classes, using constructors, multiple constructors and initialization lists, using destructors to destroy instances, friend class

UNIT III **(25% weightage)**

Operator overloading: operator overloading, working with overloaded operator methods

Initialization and assignment: Initialization vs. Assignment, copy constructor, assigning values, specialized Constructors and methods, constant and static class members

Storage management: memory allocation, dynamic allocation: new and delete

UNIT IV **(30% weightage)**

Inheritance: overview of inheritance, defining base and derived classes, constructor and Destructor calls, static and dynamic polymorphism.

Input and output in c++ programs: standard streams, manipulators, unformatted input and output, file input and output.

Tutorial: 15 Hrs.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
1-5	**C++ overview:** C++ characteristics, object-oriented terminology, polymorphism, object-oriented paradigm, abstract data types.
6-10	**Functions and variables:** functions: declaration and definition, variables: definition, declaration, and scope, variables: dynamic creation and derived data, arrays and strings in c++, qualifiers.

11-18	**Classes in c++:** defining classes in c++, classes and encapsulation, member functions, instantiating and using classes, using constructors, multiple constructors and initialization lists, using destructors to destroy instances, friend class
19-22	**Operator overloading:** operator overloading, working with overloaded operator methods
23-28	**Initialization and assignment:** Initialization vs. Assignment, copy constructor, assigning values, specialized Constructors and methods, constant and static class members
29-32	**Storage management:** memory allocation, dynamic allocation: new and delete
33-40	**Inheritance:** overview of inheritance, defining base and derived classes, constructor and Destructor calls, static and dynamic polymorphism..
41-45	**Input and output in c++ programs:** standard streams, manipulators, unformatted input and output, file input and output.
15 Hours	*Tutorials*

Text Books:

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

Reference Books:

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.

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INTRODUCTION TO DATABASE

Course Details			
Course Title: INTRODUCTION TO DATABASE			
Course Code:	MSCSC2052E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, Tutorials, self-study, Home 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 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 understand fundamentals of the SQL, a standard query language that is used to fetch desired information from the database.

Learning outcomes

After completing the course the students

- will be able to understand what is a database, what management functions it allow 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 **(25% 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 **(25% 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

Text Books:

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.
3. SQL The Complete Reference, 3rd Edition, by James Groff , Paul Weinberg, Andy Oppel, McGraw Hill Education, ISBN-13: 978-1259003882
4. MySQL Database Usage & Administration, by Vikram Vaswani, McGraw-Hill Company, ISBN-978-0-07-160550-2.

Reference Books

1. An Introduction to Database Systems, Bipin C Desai , Galgotia Publications New Delhi, ISBN-13: 978-8175157521.
2. Learning MySQL, Seyed M.M. (Saied) Tahaghoghi, Hugh Williams, O'Reilly Media (November 24, 2006), ISBN-978-0596008642.

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3. Head First SQL, Beighley Lynn, First edition, Shroff Publication, ISBN-13: 978-8184043686

INTRODUCTION TO MODELING AND SIMULATION

Course Details			
Course Title: INTRODUCTION TO MODELING AND SIMULATION			
Course Code	MSCSC2053E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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.

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)**

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, Direct transformations with Normal distributions, Acceptance Rejection techniques, with Poisson distribution, 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, study of one simulation language.

Content Interaction Plan:

Lecture cum Discussion (Each session of 1 Hour)	Unit/Topic/Sub-Topic
1-5	**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
6-10	Discrete and Continuous systems. Stages of a typical simulation study, Simulation Examples, Concepts of system Clocks, Event scheduling Vs Time advance algorithms.
11-15	**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.
16-20	**Random Numbers:** Roles of random numbers in simulation, pseudo random number generation techniques, properties, methods of testing PRN sequences.
21-25	Random variates: Generation, Inverse transformation techniques- with exponential distributions and empirical continuous distributions, Direct transformations with Normal distributions
26-30	Acceptance Rejection techniques, with Poisson distribution, Chi square test, Kolmogorov- Smirnov test
31-35	**Queuing Networks:** Analytical and simulation modeling of queuing system, M/M/1
36-40	M/M/∞, M/M/n, Performance evaluation.
41-45	**Simulation Languages:** Needs of special purpose simulation Languages, study of one simulation language.
15 Hours	*Tutorials*

Text Books:

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

Reference Books:

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: Queuing Theory and Performance Evaluation ,

Thomas G. Robertazzi - 2000, (Springer).

INTRODUCTION TO IMAGE PROCESSING

Course Details			
Course Title: INTRODUCTION TO IMAGE PROCESSING			
Course Code	MSCSC2054E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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: **(15% Weightage)**

Introduction to digital image processing, Gray scale and Colour images, Basics of MATLAB, Digital image representation: Coordinate Convention, Images as matrices, classes and image types, sampling and quantization.

UNIT II: Spatial Domain and Frequency domain Filtering: **(25% 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.

UNIT III: Wavelets and applications **(25%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 **(20% Weightage)**

Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Discrete Cosine Transform based image compression, 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, Gray scale and Colour images, Basics of MATLAB,
5-7	Digital image representation: Coordinate Convention, Images as matrices, classes and image types, sampling and quantization.
8-12	**Spatial Domain Filtering:** Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters,
13-17	**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.
18-22	**Introduction to Wavelets:** Introduction, admissibility criteria, scaling and wavelet function, Multiresolution analysis, wavelet transform: continuous wavelet transform, discrete wavelet transform,
23-28	**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.
29-33	Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding.
34-39	Discrete Cosine Transform based image compression, Discrete Wavelet Transform based image compression. **Performance Criterion:-** Mean Square Error, Peak Signal to noise ratio for images
40-45	**Morphological Image Processing:** Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components
15 Hours	*Tutorials*

- Suggested References:
- Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.
- Fundamentals of Digital Image Processing By Anil K Jain.
- 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.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Details			
Course Title: INTRODUCTION TO ARTIFICIAL INTELLIGENCE			
Course Code	MSCSC2055E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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 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.

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 .

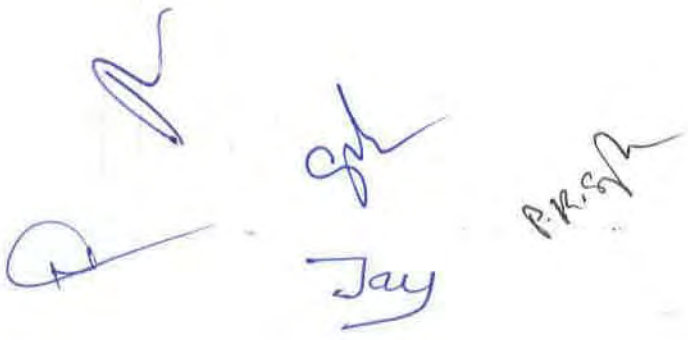
Content Interaction Plan:

Lecture cum Discussion (Each session of	Unit/Topic/Sub-Topic

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*

- Suggested References:
- 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

- "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.



INTRODUCTION TO DESIGN AND ANALYSIS OF ALGORITHMS

Course Details			
Course Title: INTRODUCTION TO DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	MSCSC2056E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
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

- 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.

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 **(15% 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 - radix sort, 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: String processing **(15%Weightage)**

String searching and Pattern matching, Knuth-Morris-Pratt algorithm and its analysis.

UNIT V: Introduction to NP-completeness **(20% Weightage)**

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

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,
5-6	quick review of common algorithm design principles.
7-14	**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 - radix sort, quick sort, merge sort..
15-22	**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.
23-25	**Hashing:** Basic ingredients, analysis of hashing with chaining and with open addressing,
26-29	Graph searching - BFS, DFS, shortest first search, topological sort; connected and biconnected components;
30-36	Minimum spanning trees - Kruskal's and Prim's algorithms, Single-Source Shortest Path, All-Pairs Shortest Paths. Backtracking: n-Queens Problem.
37-40	String searching and Pattern matching, Knuth-Morris-Pratt algorithm and its analysis.
41-45	Informal concepts of deterministic and nondeterministic algorithms, P and NP, NP-completeness, statement of Cook's theorem, some standard NP-complete problems, approximation algorithms.
15 Hours	*Tutorials*

- Suggested References:
- T. H. Cormen, C.E. Leiserson and R.L.Rivest: Introduction to Algorithms, Prentice Hall of India, New Delhi, 1998.
- Aho, J. Hopcroft and J. Ullman; The Design and Analysis of Computer Algorithms, A.W.L, International Student Edition, Singapore, 1998.
- S. Baase: Computer Algorithms: Introduction to Design and Analysis, 2nd ed., Addison-Wesley, California, 1988.

- E. Horowitz and S. Sahni: Fundamental of Computer Algorithms, Galgotia Pub./Pitman,New Delhi/London, 1987/1978.
- K. Mehlhorn: Data Structures and Algorithms, Vol. 1 and Vol. 2, Springer-Verlag, Berlin, 1984.
- Borodin and I. Munro: The Computational Complexity of Algebraic and Numeric Problems, American Elsevier, New York, 1975.