

**Master of Computer Application (MCA)**

Syllabus

**(2024-2026 Batch)**



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**NIST UNIVERSITY**  
Institute Park, Pallur Hills, Berhampur,  
Odisha, India – 761008

## 4.2.6 Master in Computer Application (MCA)

### MCA Course Structure

First - Year Course Structure (I Semester)							
S. No.	Course Category	Course Code	Course Title	L	P	T	Credits
1	CC	MCA-500	Data Structure using C	3	0	4	5
2	CC	MCA-501	Computer Organization and Architecture	3	0	0	3
3	CC	MCA-502	Database Management Systems	3	0	4	5
4	CC	MCA-503	Mathematics – I: (Mathematical Foundation of Computer Science)	3	0	0	3
5	AEC	MCA-504	Communicative English	2	0	4	4
Total Credits							20

First -Year Course Structure (II Semester)							
S. No.	Course Category	Course Code	Course Title	L	P	T	Credits
1	CC	MCA-505	Object Oriented Programming using JAVA	3	0	4	5
2	CC	MCA-506	Computer Networks	3	0	4	5
3	CC	MCA-507	Operating Systems	3	0	4	5
4	CC	MCA-508	Software Engineering	3	0	0	3
5	CC	MCA-509	Mathematics - II (Probability & Statistics)	3	0	0	3
6	AEC	MCA-510	Personality and Soft Skill Development	0	0	4	2
Total Credits							23

Second - Year Course Structure (III Semester)							
S. No.	Course Category	Course Code	Course Title	L	P	T	Credits
1	CC	MCA-600	Design and Analysis of Algorithms	3	0	4	5
2	CC	MCA-601	Data Warehousing and Data Mining	3	0	0	3
3	CC	MCA-602	Python Programming	3	0	4	5
4	CC	MCA-603	Artificial Intelligence	3	0	0	3
5	DSE	MCA-604	Department Specific Elective - I	3	0	0	3
6	PR	xxx-xxx*	Minor Project with Seminar	0	0	8	4
7	PR	MCA-611	Summer Internship	0	0	2	1
<b>Total Credits</b>							<b>24</b>

\*Course Code for PE& OE (XXX-XXX) will be one of the following.

**Department Specific Elective - I**

MCA-605: Computer Graphics and Multimedia

MCA-607: Natural Language Processing

MCA-608: Wireless Sensor Network

MCA-609: Soft Computing Techniques

MCA-610: CBOT (Computer-based optimization techniques)

Second - Year Course Structure (IV Semester)							
S. No.	Course Category	Course Code	Course Title	L	P	T	Credits
1	CC	MCA-604	Machine Learning	3	0	4	5
2	CC	MCA-605	Internet & Web Technology	3	0	4	5
3	DSE	MCA-631	Department Specific Elective - II	3	0	0	3
4	PR	MCA-682	Major Project	0	0	24	12
Total Credits							25

### Department Specific Elective – II

MCA-631A: Internet of Things (IoT)

MCA-631B: Computer Network Security

MCA-631C: Web application Development

MCA-631D: Cloud Computing

MCA-631E: Data Science

MCA-631F: Software Testing and Quality Assurance

MCA-631G: Blockchain Technology

**FIRST SEMESTER DETAIL SYLLABUS**

MCA-500	Data Structure using C (3-0-4)	5 Credits
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## Course Objective

- 1: student must be able to write programs in C
- 2: Student must have basic knowledge on Data structures
- 3: He must implement above in C language
- 4: Perform a mini project on them

## Course Outcome:

1. To understand the basics of C Programming and its constructs
2. To understand concepts about functions, pointers and structures
3. To Understand basic concepts about stacks, queues, lists with implementation in C
4. Understanding Tree data structure with types of trees

## Module- I: Introduction to Programming : (12 Hrs.)

Structure of C Program, Keywords, Identifiers, Primitive Data types, variables, constants, Operators and Expressions: Expression evaluation: Operator Precedence and Associativity. Conditional Branching: One (simple if), two (if else) and multi way selection (else if ladder and switch and nested selection), Iteration and loops: Iterative statements, nested loops, break and continue statements. Arrays & Strings: One-dimensional, Two dimensional and Multi-dimensional arrays. Sorting and Searching: Bubble sort, Selection sort, Quick sort and Merge sort. Linear and binary search,

## Module- II: Function, Pointer & Structure: (12 Hrs.)

Function: Declaration, Definition, Call by value, Call by reference, Scope of variables, Storage classes, Recursive functions. Defining pointers, pointers to 1D arrays, Pointer to function, Pointer to structure,.Dynamic memory allocation. Structure - Defining structures and Array of Structures, Structure vs Union,

## Module- III: Introduction to Data Structure:

(10Hrs.)

Abstract Data Types – Definition and Representation, ADT of Stack and Queue , Stack operations, Applications of stack- reversing string, Decimal to Binary conversion, infix to postfix. Queue: linear & circular queue. self-referential structures, Singly Linked list Double linked list operations.

## Module- IV: Tree (06 Hrs.)

Tree: Definition and Terminology, Binary tree, Strictly Binary tree, complete Binary tree and almost complete binary tree, Binary tree traversals. Binary Search Tree (BST) – Insert into BST, AVL Tree – Balance factor, Insertion into AVL and Rotations.

**Text Books:**

1. Behrouz A. Forouzan& Richard F. Gilberg, “A structured Programming Approach Using C”, 3rd Edition, Cengage Publication, ISBN: 9788131503638, 2007.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2<sup>nd</sup> Edition, Prentice Hall of India, 2015.
3. Byron Gottfried, Schaum's Outline of Programming with C, 3<sup>rd</sup> Edition, McGrawHillBook, 1<sup>st</sup> July 2017.
4. Data Structures: A Pseudocode Approach with C – Gilberg&Forouzan, 2<sup>nd</sup> Edition, Cengage, Indian Reprint 2016
5. Data Structures and Program Design in C – Kruse, Leung, 2<sup>nd</sup> Edition, Pearson,2008

<b>Course Name</b>	<b>Programming and Data Structures</b>
<b>Course Link</b>	<b><a href="https://nptel.ac.in/courses/106105085/4">https://nptel.ac.in/courses/106105085/4</a></b>
<b>Course Instructor</b>	<b>Dr. P. P. Chakrabarti Department of Computer Science and Engineering Indian Institute of Technology Kharagpur</b>

MCA-501	<b>Computer Organization and Architecture (3-0-0)</b>	<b>3 Credits</b>
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### Course Objectives:

1. Able to understand the basic organizational structure of computer system along with the operational concepts, the concepts of ALU, CU and Memory design, the concept of cache memory, virtual memory and principle of pipelining.
2. Able to solve the problems related to cache memory and performance, page replacement algorithms, memory construction, arithmetic operations, and pipelining.
3. Able to explain and apply the basic concepts of memory, its construction and analysis of performance related memory hierarchy.
4. Able to analyze the performance differences of computing evolution on basic operation like addition, multiplication and division, page replacement algorithms and cache memory mappings.

### Module-I: (10 hrs)

Functional blocks of a computer: CPU, memory, input-output subsystems, Von-Neumanvs Harvard Architecture, Instruction set architecture of a CPU–registers, instruction execution cycle, BasicOperational Concepts, addressing modes, instruction set. Case study – instruction sets of somecommon CPUs.

### Module-II (10 hrs)

Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder,etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring andnon-restoring techniques, signed number representation, fixed and floating-point representations,floating point arithmetic.

### Module-III (10 hrs)

Memory system design: semiconductor memory technologies, memory organization.

Memory organization: Memory interleaving, concept of hierarchical memory organization, cachememory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

### Module-IV (10 hrs)

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions,software interrupts and exceptions. Basic concepts of pipelining, throughput, speedup and efficiency,pipeline hazards: Structural hazards, data hazards, control hazards.

### Course Outcomes:

1. Understand the basic organization of computer and instruction execution cycles along with their instruction formats and different addressing modes.
2. Gain knowledge on the architectural and circuit level design of arithmetic logic unit & control unit and can solve different arithmetic problems.
3. Explain and apply the basic concepts of memory, its construction and analysis of performance related memory hierarchy.
4. Gain knowledge on the different I/O interfaces, modes of data transfer and basic principles of pipelining.

## TEXT BOOKS:

1. “Computer Organization” 5<sup>th</sup> edition Carl Hamacher, Zvonkovranesic, SafwatZaky, McGraw Hill.
2. “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

## REFERENCE BOOKS:

1. “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill.
2. “Computer Organization and Architecture: Designing for Performance”, 10th Edition by William Stallings, Pearson Education.
3. “Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

<b>Course Name</b>	<b>Computer Organization and Architecture</b>
<b>Course Link</b>	<a href="https://nptel.ac.in/courses/106/106/106106166/">https://nptel.ac.in/courses/106/106/106106166/</a>
<b>Course Instructor</b>	<b>V. Kamakoti Indian Institute of Technology Madras, Chennai, India.</b>

<b>MCA-502</b>	<b>Database Management Systems (3-0-0)</b>	<b>5 Credits</b>
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**Course Objective:**

1. Introducing basic database concepts like E-R Diagram, Relational Algebra,
2. Designing Normalized databases
3. Advantages, disadvantages and implementation of NoSQL database design in contrast to SQL based database.
4. Introducing database transactions

**Module-1: (10 Hours)**

Introductory concepts of DBMS: Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- levels, Mappings. Entity-Relationship model: Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets. Reduction to E-R database schema.

**Module-2: (10 Hours)**

Database Programming: Relational Algebra and calculus (Domain and Tuple relational calculus) Basics of SQL, DDL, DML, creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands –Commit, Rollback, save point. Concepts, Cursors, Stored Procedures, Stored Function, and Database Triggers.

**Module-3: (10 Hours)**

Normalization of Databases: Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1NF, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multi- valued dependency, 4NF, Join dependency and 5NF.

**Module-4: (10 Hours)**

Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol. User security, grants, privileges, roles, access control. Introduction to NoSQL.

**Course Outcome:**

1. Designing database and manipulating data for different real life problems
2. Apply SQL queries for retrieving columns using functions and related database.
3. Displaying data from multiple table using join and sub-queries
4. Designing and differentiating solutions using schema based database.

**Suggested Books:**

1. Elmasari;Navathe, Fundamentals of Database System, Seventh Edition, Pearson Education Book .
2. Sudarshan, Korth, Database System Concepts, 6th edition, McGraw-Hill Education Book .
3. Prof. ParthaPratim Das, Department of Computer Science & Engineering, IIT Kharagpur [https://onlinecourses.nptel.ac.in/noc18\\_cs15/preview](https://onlinecourses.nptel.ac.in/noc18_cs15/preview)
4. Prof. Arnab Bhattacharya, IIT Kanpur <https://nptel.ac.in/courses/106104135/>
5. Dr. Leo Mark, Georgia Institute of Technology, <https://in.udacity.com/course/database-systems-concepts-design--ud150>

MCA-503	<b>Mathematics-I(Mathematical foundation of Computer Science)(3-0-0)</b>	<b>3 credit</b>
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**COURSE OBJECTIVES:**

- Apply the knowledge of matrix to compute Eigen values, Eigen vectors, solve system of linear equations, inverse of matrices.
- To develop logical thinking and its applications to computer science.
- Mathematical (computing, reasoning, analytic, and geometric) approach to data analysis.
- To understand the concept of graphs, theory and their application in solving practical network based problems.

**SYLLABUS**

**Module-I: Systems of Linear Equations, Eigen Values and Eigen Vectors** [8 Hrs]  
 Basic concept of matrix and its operation, System of linear equations (Gauss-Elimination and Gauss-Jordan method), Rank of a matrix, Existence and uniqueness of solution of linear systems, Inverse of matrices (Gauss-Jordan Method), Eigen values and Eigen vectors of a matrix with their properties.

**Module-II: Logic and Counting Principle** [9 Hrs]  
 Logic: Propositions, Propositional equivalences, Predicate and quantifiers, Rules of inference, Introduction to proofs, Mathematical induction.  
 Counting: The basics of counting, the Pigeonhole principle, Permutations and combinations, Recurrence relations, Solving linear recurrence relations, Generating functions, Inclusion-Exclusion and applications of Inclusion-Exclusion.

**Module-III: Relations, Elementary Algebraic Structure** [08 Hrs]  
 Relations: Relations and their properties, n-ary relations and their applications, Representing relations, Closures of relations, Equivalence relations, Partial orderings.  
 Definition and elementary properties of groups, subgroups, ring, fields, and vector spaces.

**Module-IV: Lattice and Boolean Algebra** [07 Hrs]  
 Boolean Algebras: Lattices and algebraic systems, Principle of duality, Basic properties and algebraic systems defined by lattices, Distributive and complemented lattices, Boolean lattices and Boolean algebras.

**Module-V: Graph Theory** [08 Hrs]  
 Introduction to graphs, Graph Terminology, Representing Graphs and Graph Isomorphism, Euler and Hamilton Paths, Shortest Path Problem, Dijkstra’s Algorithm, Planar Graphs (Euler’s formula and its applications only), Graph colouring.  
 Trees: Introduction to Trees, Spanning Tree, Minimum Spanning Tree, Kruskal’s Algorithm, Prim’s Algorithm,

**OUTCOMES**

1. Application of matrix theory and linear algebra to solve system of equations .
2. Applying set theory and logic to solve the real valued problems easily.
3. Solving different problems suing Lattice..

4. Solving different practical network based problems through graphical methods..

## TEXT BOOKS

1. K. H. Rosen, *Discrete Mathematics and Its Applications*, 6<sup>th</sup> Edition, Tata McGraw Hill Publication. [Chapters - 1(1.1 – 1.3, 1.5 – 1.6), 4(4.1), 5(5.1 – 5.3), 6(6.1 – 6.2, 6.4 – 6.6), 7(7.1 – 7.6), 8(8.1 – 8.3, 8.5 – 8.8), 9(9.1, 9.4, 9.5)]
2. C. L. Liu and D. P. Mohapatra, *Elements of Discrete Mathematics–A Computer Oriented Approach*, 4<sup>th</sup> Edition, Tata McGraw Hill, 2013. [Chapter – 10(10.1 – 10.3, 10.10), 11(11.1 – 11.5)]
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10<sup>th</sup> Edition, Willey. [Chapter – 7(7.1 – 7.5, 7.8)]

## REFERENCE BOOKS

1. B. Kolman, R.C. Busby, and S.C.Ross, *Discrete Mathematical Structures*, Pearson Education.
2. J. P. Trembly, and R. Manohar, *Discrete Mathematical structures with Applications to Computer Science*, Tata McGraw Hill.

MCA-590	<b>Communicative English (2-0-0)</b>	<b>4 Credits</b>
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**Course Objectives:**

1. To communicate effectively by developing competent textual, visual, and non-verbal communication abilities.
2. To draft effective formal written business messages in various formats and styles.
3. To learn the skills to effectively deliver formal oral presentations to a variety of audiences in multiple contexts
4. To be acquainted with the soft skills and various selection procedures adopted by the recruiters.

**Course Outcomes:**

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

1. Become adept in their use of the spoken word in interpersonal communication, small group interaction and public speaking.
2. Use an appropriate style and format to write letters (Formal and Informal), prepare result-oriented reports, prepare CVs and draft business documents.
3. Gather and prepare information and apply it to persuade or articulate one's own point of clearly and efficiently.
4. Comprehend the employability market, identify the organizations to get good placements and broad career plans by developing all-round personality.

## **SYLLABUS**

### **Unit-1: Understanding Fundamentals of Communication**

Significance of Communication Skills, 7Cs of communication, Process and Factors of Communication, communication Barriers, Difference between General and Technical Communication, Verbal and Non-verbal Communication, Formal and Informal channels of Communication.

### **Unit-2 Learning Verbal Communication**

Introduction to Phonetics, IPA Chart, British Received Pronunciation, Presentation Skills, Group Discussion, Interview Skills. Decoding Body language for communication impact  
.Persuasive communication

## Unit-3 Learningwrittencommunication

Fundamentals of Sentence construction. Using Figures of Speech (Simile, Metaphor,Irony, Personification, Onomatopoeia, Alliteration), Phrasal Verbs, Derivatives andmeaningofwords,Idioms,Onewordsubstitution,HomonymsandHomophones. CreativeWriting:CopywritingSkills,Storyboardwriting.Barrierstoeffectivewriting.

## **Unit-4 ImprovingReadingandListeningskillsforeffectivecommunication**

Types of Reading, Sub-skills of reading (Skimming, Scanning, Reading Comprehension)ListeningSkills.PurposeofListening.ListeningtoConversation(FormalandInforma l)ActiveListening.Benefits ofEffectiveListening.BarrierstoListening

## **Unit-5 ProfessionalWriting**

Letter, Memo, Circular, Proposal, E-mail, Resume Writing , Cover Letters, Minutes ofMeeting.

### ReferenceBooks:

1. CommunicationSkillsbySanjayKumarandPushpaLata,OxfordUniversityPress.
2. TechnicalCommunication,PrincipleandPracticebyMeenakshiRamanandSangeetaSharma,OxfordUniversityPress.
3. ACourseinEnglishPhoneticsbyT.R.Kansakar,OrientLongmenPress.
4. BasicCommunicationSkillsfortechology-AndreaJRutherford,Pearson
5. EnglishGrammar,WrenandMartin

22MC107	Data Structure Laboratory (0-0-4)	2 Credits
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### Course Objective:

This course is aimed at concepts of programming and software code development of moderate complexity using C programming language within the framework of structural and procedural programming paradigms and data structure.

### List of Suggested Programs

1. Familiarity with basic LINUX command, vi editor.
2. Programs on arithmetic expressions, data type limits, operators and precedence.
3. Programs on Conditional Branching and Loops.
4. Programs on 1D and 2D array handling.
5. Programs on String handling and Functions
6. Programs on Pointers and Structure.
7. Implementation of Stack and Queue
8. Infix to Postfix conversion, Insertion sort
9. Linear and Binary Search
10. Bubble sort, Merge sort and Quick sort.

### Course Outcomes:

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

1. Understand problem solving approach of moderate complexity in Linux environment.
2. Design and develop C program to solve different real life problems efficiently.
3. Analyse and compare different possible solutions.

1. Retrieving Data Using the SQL SELECT Statement.
2. Restricting and Sorting Data.
3. Manipulating Data.
4. Using DDL Statements to Create and Manage Tables.
5. Using Single-Row Functions to Customize Output.
6. Reporting Aggregated Data Using the Group Functions.
7. Displaying Data from Multiple Tables.
8. Using Sub queries to Solve Queries.
9. Creating Other Schema Objects (indexes, views).
10. User security (privileges, roles).
11. Cursors and composite data types...
12. Functions and procedures.
13. Packages.
14. Triggers.
15. Mini project (Application Development )

Suggested Books: Murach's My SQL: Joel Murach , 2nd Edition.

22MC109	Communicative English Laboratory (0-0-4)	2 Credits
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(This unit involves interactive practice sessions in Language Lab)

1. **Listening Comprehension**
2. **Pronunciation, Intonation**
3. **Stress and Rhythm practice**
4. **Common Everyday Situations: Conversations and Dialogues**
5. **Formal Presentations**
6. **Reading Comprehension**
7. **Report writing**
8. **Writing letters, e-mails,**
9. **Writing essay, CV, etc...**
10. **Grammar activities**

**SECOND SEMESTER DETAIL SYLLABUS**

## SECOND SEMESTER DETAIL SYLLABUS

MCA-505	Object Oriented Programming using JAVA	5 Credits
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### Course Objective

1. Understand the basic object-oriented programming concepts and apply them in problem solving.
2. Illustrate inheritance concepts for reusing the program.
3. Students will be able to learn about Multi-Threading, String Handling and Java I/O.
1. Students will Develop and implement Graphical User Interface(GUI) Applications in Java using AWT and Swing

### Course Outcome:

1. Understand and implement various Object Oriented Concepts like inheritance, abstraction and polymorphism.
2. Work with Collection Classes and Files, Multiple Threads, & handle Exceptions.
3. Develop applications to interact with a Database.
4. Design and implement Graphical User Interface(GUI) Applications in Java using AWT and Swing.

### Module- I

(8 Hours)

Introduction to Java and Java programming environment. Object Oriented Programming Concepts: Encapsulation, Abstraction, Inheritance, Polymorphism. Fundamental Programming Structure: Data Types, variable, keywords, typecasting, Arrays, Operators and their precedence. Control Flow: Java's Control Statements (if, switch, iteration, statement, while, do-while, for, Nested loop). Concept of Objects and Classes, Using Existing Classes building your own classes, constructor overloading, static, final, this keyword.

### Module - II

(8 Hours)

Inheritance: Introduction, types of inheritance. Use of super keyword. Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.Packages & Interfaces: Packages, Access Protection, importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Exception Handling: Fundamentals, Types Checked, Unchecked exceptions, Using try & catch, Multiple catch, throw, throws, finally, Java's Built in exceptions, user defined exception.

### Module -III

(8 Hours)

Multi-Threading: Java Thread Life Cycle, Thread Priorities, Synchronization, Creating a thread, Runnable interface, Creating Multiple threads, Using isAlive () and join (), wait () & notify(). String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string.Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

### Module IV

(6 Hours)

Wrapper Classes: Wrapper classes and its methods.

Collection Framework: Introduction, interfaces, List, Set, Map etc, List interfaces and its classes.

Introduction to Database: Introduction to Database. Driver Types, RegisteringDriver, Creating Connection, Executing SQL query using Statement, PreparedStatement, ResultSet methods.

**Module V** (10 Hours)

Event Handling: Event Delegation Model, Event Classes, Event Listener Interfaces, Adapter classes. AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame, working with Graphics, Control Fundamentals, Layout managers, Handling Events by Extending AWT components.

Swing: Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables.

**Text Books:**

1. Java: One Step Ahead by Anita Seth (Author), B.L. Juneja (Author) Oxford University Press.
2. Head First Java 2nd edition Kathy Sierra & Bert Bates 3. JAVA Complete Reference (9th Edition) Herbert Schildt.
4. <https://www.udemy.com/java-the-complete-java-developer-course/>
5. Java Programming Masterclass for Software Developers Created by Tim Buchalka, Tim Buchalka's Learn Programming Academy, GoranLochert

<b>Course Name</b>	<b>Object Oriented Programming using JAVA</b>
<b>Course Link</b>	<b><a href="https://onlinecourses.nptel.ac.in/noc21_cs03/preview">https://onlinecourses.nptel.ac.in/noc21_cs03/preview</a></b>
<b>Course Instructor</b>	<b>Prof. Debasis Samanta Dept. Computer Science and Engineering from Indian Institute of Technology, Kharagpur</b>

MCA-506	Computer Networks (3-0-0)	3 Credits
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**Course Objective:**

1. Understand the concepts of data communication, layered model, wireless devices in computer networks.
2. Students will be able to understand the various techniques used to access a shared channel in the network and IEEE specifications for LANs.
3. Students will learn about different types of networking devices, backbone networks and Internet Protocol (IP) addressing.
4. Understand the responsibilities of network, transport and application layers.

**Module – I****(12 Hrs)**

Overview of Data Communication Networks, Design issues, structure and topology, Protocols and standards, OSI Reference model, TCP/IP Protocol.

Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, multiplexing: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM),

Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, packet switching, Datagram Network, Virtual-Circuit Network, Telephone Network, Dial-up Modems and Digital Subscriber Lines.

**Module – II****(12 Hrs)**

Error Detection and correction: Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding. Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing), Channelization (FDMA, TDMA, and CDMA). Wired LANs (Ethernet): Traditional Ethernet, Fast Ethernet, and Gigabit Ethernet.

**Module – III****(06 Hrs)**

Wireless LANs: IEEE 802.11 and Bluetooth2.0.

Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway.

Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers.

**Module – IV****(10 Hrs)**

Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols.

Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document, HTTP: Transaction & Persistent vs. Non-persistent connection. Introduction to Wi-Fi and Li-Fi Technology.

**Course Outcome:**

1. Understand the layered communication architectures (OSI and TCP/IP) and different transmission techniques for communication over a network.
2. Recognise devices used in 3 lower layers. Understand and apply flow and error control during data transmission with the associated protocols and mechanism of channel access methods.
3. Understand and apply host addressing logic & subnetting concepts with associated protocols of network layer and transport layer.
4. Understand protocols involved in application layer to facilitate high level applications.

**Suggested Books and Online Resources:**

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill, 5<sup>th</sup>Edition(2013).
2. Computer Networks, A. S. Tannenbum, D. Wetherall, Pearson Education, 5<sup>th</sup>Edition(2014).
3. Data and Computer Communications, William Stallings, Pearson Education, 10<sup>th</sup>Edition(2018).
4. Computer Networking, A Top-Down Approach, James F. Kurose, Keith W. Ross, Pearson publication, 6<sup>th</sup>Edition(2017).
5. <http://www.nptelvideos.in/2012/11/computer-networks.html>, Prof. SujoyGhosh, IIT, Kharagpur.

Course Name	COMPUTER NETWORKS AND INTERNET PROTOCOL
Course Link	<a href="https://nptel.ac.in/courses/106105183/">https://nptel.ac.in/courses/106105183/</a>
Course Instructor	Prof. Soumya Kanti Ghosh, IIT, Kharagpur.

Course Name	Introduction to Computer Networking
Course Link	<a href="https://www.classcentral.com/course/stanford-openedx-introduction-tocomputer-networking-1578">https://www.classcentral.com/course/stanford-openedx-introduction-tocomputer-networking-1578</a>
Course Instructor	Prof. Philip Levis and Professor Nick McKeown, Stanford University

<b>MCA-507</b>	Operating Systems	<b>5 Credits</b>
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**Course Objectives:**

1. Student will be able to understand the basic components of a computer operating system, and the interactions among the various components.
2. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.
3. Students will be able to understand the concepts of virtual memory management, file system.
4. Students will be able to understand the concepts of secondary storage structure, protection and case study of Linux operating system.

**Module-I: (10 Hrs.)**

Overview: Operating System, Simple Batch Processing Systems, Multiprogramming and Time-sharing systems Operating System Structures, Operating System Services and system calls.

Process: Process Concept, Process Scheduling, Operation on Processes, Inter-process communication, Examples of IPC Systems, Multithreading Models, Threading Issues.

**Module-II: (10 Hrs.)**

Process Scheduling: scheduling criteria, scheduling algorithms

Process Synchronization: Critical section problem, two-process and multi-process solutions, Semaphores, Classical problems of synchronization, Monitors.

Deadlocks: System model, Deadlock Characterization, Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection and recovery from Deadlock.

**Module-III: (10 Hrs.)**

Memory Management: Memory Management strategies, Logical versus Physical Address space, swapping, contiguous Allocation, Paging, Segmentation.

Virtual Memory: Background, Demand paging, performance of Demand paging, Page Replacement, Page Replacement Algorithms, Allocation of frames, Thrashing and its prevention, Paging with segmentation

**Module-IV: (10 Hrs.)**

File system: file structure, file operations, file access methods, Directory Structure, Directory Implementation, and Allocation Methods

Mass Storage: Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management

**Course Outcome:**

1. Understand the different services provided by Operating System at different level and the design structure and learn real life applications of the same.

2. Solve and implement different process scheduling algorithms, synchronization techniques and methods of handling deadlock.
3. Describe different memory management techniques and solve problems related to paging, segmentation, fragmentation and page replacement.
4. Use concepts of file management, disk management and solve problems regarding file allocation methods and disk scheduling.

## Suggested Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Concepts, 8th edition, Wiley-India, 2009
2. William Stallings, Operating Systems: Internals and Design principles, 6<sup>th</sup> Edition, PHI Learning Pvt. Ltd, 2010
3. H.M. Deitel, P. J. Deitel, D. R. Choffnes, Operating Systems, 3rdEdition, Pearson Education, Dec 2003
4. Andrew S. Tanenbaum: Mordern Operating Systems, 4<sup>th</sup> Edition, Pearson Education, 2014
5. NareshChouhan: Principles of Operating System, Oxford University Press.

## Web Courses/Online courses

Course Name	INTRODUCTION TO OPERATING SYSTEMS
Course Link	<a href="https://nptel.ac.in/courses/106106144/2">https://nptel.ac.in/courses/106106144/2</a>
Course Instructor	Prof. Chester Rebeiro, IIT Madras

MCA-508	Software Engineering	3 credit
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**Course Objectives:**

- 1. To understand the rationale for software development process models**
- 2. To learn how to develop requirement specification for software development**
- 3. To understand the importance of architectural design and software testing methods**
- 4. To learn how to manage software development projects, software quality and ensure software reliability**

**Module-I:**

(10 Hrs.)

Introduction to software engineering, key aspects of SE, SDLC, Software Development process models: Waterfall, V-model, Incremental, RAD, Iterative, Spiral, Prototype, and Agile software development model: Agile methods, Extreme programming, Agile Process models: Adaptive software development, Scrum, Crystal.

**Module-II:**

(10 Hrs.)

Requirements engineering: Functional and non-functional requirements, software requirements specification (SRS), Requirements engineering process, Requirements elicitation and analysis, Requirements validation & management.

Object-oriented design using UML: Object oriented concepts, Dynamic and Functional Modelling, System modelling: Building Context models, Structural models, Behavioural models, and Interaction models using UML.

**Module-III:**

(10 Hrs.)

Architectural design: Architectural views, Architectural patterns, Application architectures, cohesion and coupling, Software measurement and metrics, Software testing methods: Blackbox and Whitebox testing, unit testing, integration testing, system testing, software verification and validation, Software Maintenance.

**Module-IV:**

(10 Hrs.)

Software project management: Risk management, managing people, Project planning, Project scheduling, Software cost estimation, COCOMO model.

Software Quality Management, Configuration management, Software reuse and reliability.

Component based software engineering, Service-oriented Software Engineering

## Course Outcome:

1. **To understand the phases of software development**
2. **To be able to develop software requirement specifications for different types of software and also use UML as a design tool**
3. **To understand the architectural design of software systems and various software testing techniques**

## TEXT BOOKS

1. Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, PHI, 2018

## REFERENCE BOOKS

1. Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill.
2. Fundamentals of Software Engineering, Rajib Mall, PHI, 2014.
3. Software Engineering, I. Sommerville, 9th Ed., Pearson Education.

## Digital Learning Resources

Course Name	SOFTWARE ENGINEERING
Course Link	<a href="https://nptel.ac.in/courses/106105182/">https://nptel.ac.in/courses/106105182/</a>
Course Instructor	PROF. RAJIB MALL Dept. of Computer Science and Engineering, IIT Kharagpur

MCA-509	<b>Mathematics - II</b> <b>(Probability &amp; Statistics)</b>	<b>3 Credits</b>
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**Course Objectives:**

5. Enrich the knowledge of probability on single random variables and probability distributions.
6. Understand the foundations for classical inference involving confidence intervals and hypothesis testing.
7. Analyse the given data for appropriate test of hypothesis.
8. Apply the concept of correlation and regression.

**Module-1: Fundamentals of Probability** [6 hrs]

Sample Space, Events, Counting sample points, Probability of an event, Additive Rules, Conditional Probability, Multiplicative rules, Baye's Rule.

**Module-2: Random Variables and Probability Distributions** [10 hrs]

Discrete and continuous random variables, Discrete and continuous probability distributions, Joint probability distribution, Mathematical expectation: mean, variance and standard deviation of a probability distribution. Binomial distribution, Poisson distribution and Poisson process, Normal distribution, Areas under the normal curve, Applications of the normal distribution, Normal approximation to the binomial.

**Module-3: Fundamental Sampling and Estimations** [10hrs]

Random Sampling, Some important statistics, Sampling distribution: Sampling distribution of mean and variance, t-distribution, Statistical inference, Classical methods of estimation, Single sample: estimating the mean, Standard error of point estimate, Prediction intervals, estimation of variance.

**Module-4: Testing of Hypothesis** [8 hrs]

Statistical hypothesis, Testing a statistical hypothesis, One and two tailed tests, Decision making in testing hypothesis, Test concerning a single mean, Goodness of fit test.

**Module-5: Correlation and Regression** [6 hrs]

Bivariate distribution, Correlation, Scatter Diagram, Karl Pearson coefficient of correlation, Calculation of the Correlation Coefficient for a Bivariate Frequency Distribution, Probable Error of Correlation Coefficient, Rank Correlation, Regression.

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## **COURSE OUTCOMES**

On completion of this course, students are able to:

CO-1: Use the basic probability rules, discrete and continuous probability distributions, including requirements of mean and variance.

CO-2: Identify the characteristics of different discrete and continuous distributions. Identify the type of statistical situation to which different distributions can be applied.

CO-3: Use of continuous distribution and various hypothesis of testing.

CO-4: Employee the principles of linear regression and correlation and significance of the correlation coefficient.

## **TEXT BOOKS**

1. R. E. Walpole, S. L. Myers, and K. Ye, *Probability and statistics for engineers and scientists*, 8<sup>th</sup> Edition, Pearson. [Chapter- 2, 3(3.1 – 3.4), 4(4.1 – 4.3), 5(5.3 and 5.6), 6(6.1 – 6.5), 8(8.1, 8.2, 8.4 – 8.7), 9(9.1 – 9.6, 9.12), 10(10.1 – 10.7, 10.14)]
2. S. C. Gupta, V. K. Kapoor, *Fundamental of Mathematical Statistics*, 10<sup>th</sup> revised edition, Sultan Chand & Sons. [Chapter- 10(10.1 – 10.7)]

## **REFERENCE BOOKS**

1. J. E. Freund, *Mathematical Statistics*, 5<sup>th</sup> Edition, Prentice Hall of India pvt. Ltd., Eastern Economy Edition.
2. D. C. Montgomery and G. C. Runger, *Applied Statistics and Probability for Engineers*, 6<sup>th</sup> Edition, Wiley.
3. R. C. Johnson, *Probability and Statistics for Engineers*, 6<sup>th</sup> Edition, Prentice Hall of India pvt. Ltd., Eastern Economy Edition.

MCA-504	Communicative English	2 credit
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## Course Objectives:

1. To communicate effectively by developing competent textual, visual, and non-verbal communication abilities.
2. To draft effective formal written business messages in various formats and styles.
3. To learn the skills to effectively deliver formal oral presentations to a variety of audiences in multiple contexts
4. To be acquainted with the soft skills and various selection procedures adopted by the recruiters.

### **Unit-1: Understanding Fundamentals of Communication 8Hrs**

Significance of Communication Skills, 7Cs of communication, Process and Factors of Communication, communication Barriers, Difference between General and Technical Communication, Verbal and Non-verbal Communication, Formal and Informal channels of Communication.

### **Unit-2 Learning Verbal communication 10 Hrs**

Introduction to Phonetics, IPA Chart, British Received Pronunciation, Presentation Skills, Group Discussion, Interview Skills. Decoding Body language for communication impact. Persuasive communication

### **Unit-3 Learning written communication 12 Hrs**

Fundamentals of Sentence construction. Using Figures of Speech (Simile, Metaphor, Irony, Personification, Onomatopoeia, Alliteration), Phrasal Verbs, Derivatives and meaning of words, Idioms, One word substitution, Homonyms and Homophones. Creative Writing: Copy writing Skills, Story board writing. Barriers to effective writing.

Professional Writing: Letter, Memo, Circular, Proposal, E-mail, Resume Writing, Cover Letters, Minutes of Meeting.

### **Unit-4 Improving Reading and Listening skills for effective communication 10 Hrs**

Types of Reading, Sub-skills of reading (Skimming, Scanning, Reading Comprehension)  
Listening Skills. Purpose of Listening . Listening to Conversation (Formal and Informal)  
Active Listening. Benefits of Effective Listening. Barriers to Listening

## **Course Outcomes:**

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

1. Become adept in their use of the spoken word in interpersonal communication, small group interaction and public speaking.
2. Use an appropriate style and format to write letters (Formal and Informal), prepare result-oriented reports, prepare CVs and draft business documents.
3. Gather and prepare information and apply it to persuade or articulate one's own point of clearly and efficiently.
4. Comprehend the employability market, identify the organizations to get good placements and broaden career plans by developing all-round personality.

## **Reference Books:**

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press.
  2. Technical Communication, Principle and Practice by Meenakshi Raman and Sangeeta Sharma, Oxford University Press.
  3. A Course in English Phonetics by T.R. Kansakar, Orient Longmen Press.
  4. Basic Communication Skills for technology- Andrea J Rutherford, Pearson
  5. English Grammar, Wren and Martin
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## Course Objective:

1. Learn and implement Programs with the syntax, semantics and idioms of the Java programming language.
2. Gain confidence in object-oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries.
3. Students will able to learn about. Multi-Threading, String Handling and Java I/O.
4. Students will Develop and implement Graphical User Interface(GUI) Applications in Java using AWT and Swing

## Lab Assignments

1>Data types & variables, decision control structures: if, nested if etc Loop control structures: do, while, for etc.

2.Classes and objects.

3.Data Abstraction & Data hiding, Inheritance.

4.Interfaces and inner classes, wrapper classes.

5.Exception handlings

6.Threads

7.IO Files

8.Collections

9.Database Connectivity.

10.Applets AWT and Swing.

## Course Outcome:

1. Understand and implement various Object-Oriented Concepts like inheritance, abstraction and polymorphism.
2. Work with Collection Classes and Files, Multiple Threads, & handle Exceptions.
3. Develop applications to interact with a Database.
4. Design and implement Graphical User Interface (GUI) Applications in Java using AWT and Swing.

## Course Objective:

1. Understand the concepts of data communication, layered model, wireless devices in computer networks.
2. Students will be able to understand the various techniques used to access a shared channel in the network and IEEE specifications for LANs.
3. Students will learn about different types of networking devices, backbone networks and Internet Protocol (IP) addressing.
4. Understand the responsibilities of network, transport and application layers.

## Lab Assignments

1. Introduction to LAN hardware and IP addresses configuration
2. Understanding and use of networking tools: ifconfig, ping, traceroute, arp, dig and nslookup
3. Configuration of CISCO Switches and Routers.
4. Study of network traffic using Wireshark filters.
5. Controlling of network scenario using Netem and tc.

6 to 8 are based on the following experiments:

- i. Simulate a three node point to point network with duplex links between them. Set queue size and vary the bandwidth and find number of packets dropped.
- ii. Simulate a four node point to point network with the links connected as follows:  $n_0 - n_2$ ,  $n_1 - n_2$  and  $n_2 - n_3$ . Apply TCP agent between  $n_0 - n_3$  and UDP agent between  $n_1 - n_3$ . Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP / UDP.
- iii. Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
- iv. Simulate an Ethernet LAN using 'n' nodes, change error rate and data rate and compare throughput.
- v. Simulate an Ethernet LAN using 'n' nodes and set multiple traffic nodes and plot congestion window for different source / destination.

9 to 10 are based on the following experiments to be implemented in C/Java:

- i. Implementation of Distance Vector Algorithm to find suitable path for transmission.
- ii. Program for ERROR detecting code using CRC-CCITT (16bit).
- iii. Using TCP/IP Sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.
- iv. Program for CLIENT SERVER communication using message Queues or FIFOs as IPC channels that client sends the file name and the server to send back the contents of the requested file if present.
- v. Program for Congestion control using Leaky Bucket Algorithm.

	Operating System Laboratory	
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## Course Objective:

1. To write UNIX shell scripting.
2. To understand and implement IPC mechanism using named and unnamed pipes.
3. To implement the scheduling algorithms.
4. To develop solutions for synchronization problems using semaphores.
5. To implement Deadlock avoidance algorithms.
6. To implement page replacement algorithms

## Lab Assignments

1. Practicing of basic UNIX Commands as well as Linux administrative commands
2. UNIX Shell Programming covering array, string and functions
3. Shell scripting using GREP commands.
4. Shell scripting using AWK commands.
5. Inter Process Communication (IPC) using Pipes.
6. Programs on signals and system calls
7. Implement the algorithms of CPU scheduling algorithms like FCFS, SJF, SRTF, Priority and RR using C/C++.
8. Write C/C++ programs to implement the classical synchronization problems like Dining Philosopher and reader-writer problems using semaphore.
9. Implementation of deadlock avoidance algorithm using C/C++.
10. Implementation of page replacement algorithms like FIFO, LRU and Optimal.

	Personality and Soft Skill Development (0-0-4)	
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1. Soft Skills – Self Analysis, Creativity, Attitude, and Goal Setting
2. Personality development - Interpersonal Skills, Leadership Skill, and Decision making
3. Business Writing- Structure and Impact of Business writing
4. Etiquette and Manners – Modern Etiquette, Benefits, Social Manners and Corporate Grooming
5. Stress Management - Kinds of Stress, Spotting stress, Emotional intelligence and managing emotions
6. Group Discussion – Group Dynamic, Lateral Thinking, Brainstorming and Negotiation Skills
7. Team Skills- Team Structure and Team Dynamic
8. Interview Skills – Concept and Process of Interview, Pre-preparation and Answering Strategies
9. Presentation Skills – Planning, Practicing and Delivering Presentation
10. Conflict Resolution – Conflict in Human Relations, Approaches to conflict resolutions.