Master of Computer Application (MCA)
Third Semester Detailed Syllabus

(2023-2025 Batch)

NIST INSTITUTE OF SCIENCE & TECHNOLOGY
(AUTONOMOUS),
Institute Park, Pallur Hills, Berhampur,
Odisha, India – 761008

MCA Programme Structure (2023-2025 Batch)

First Semester					
Theory					
Sl. No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	IT	22MC101	Data Structure using C	3-0-0	3
2	IT	22MC102	Computer Organization and Architecture	3-0-0	3
3	IT	22MC103	Database Management Systems	3-0-0	3
4	MATH	22MC104	Mathematics – I: (Mathematical Foundation of Computer Science)	3-0-0	3
5	BM	22MC105	Communicative English	2-0-0	2
Total Credit (Theory)					14
Practical					
1	LAB	22MC107	Data Structure Laboratory	0-0-4	2
2	LAB	22MC108	Database Management Systems Laboratory	0-0-4	2
3	LAB	22MC109	Communicative English Laboratory	0-0-4	2
4	SEM	22MC110	Seminar	0-0-2	1
Total Credit (Practical)					7
Total Semester Credit					21

Second Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	IT	22MC201	Object Oriented Programming using JAVA	3-0-0	3
2	IT	22MC202	Computer Networks	3-0-0	3
3	IT	22MC203	Operating Systems	3-0-0	3
4	IT	22MC204	Software Engineering	3-0-0	3
5	MATH	22MC205	Mathematics - II (Probability & Statistics)	3-0-0	3
6	BM	22MC210	Environmental Science	3-0-0	0
Total Credit (Theory)					15
Practical					
1	LAB	22MC206	Object Oriented Programming using Java Laboratory	0-0-4	2
2	LAB	22MC207	Computer Networks Laboratory	0-0-4	2
3	LAB	22MC208	Operating Systems Laboratory	0-0-4	2
4	LAB	22MC209	Personality and Soft Skill Development	0-0-4	2
Total Credit (Practical)					8
Total Semester Credit					23

Third Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	IT	22MC301	Design and Analysis of Algorithms	3-0-0	3
2	IT	22MC302	Data and Web Mining	3-0-0	3
3	IT	22MC303	Python Programming	3-0-0	3
4	IT	22MC314	Artificial Intelligence	3-0-0	3
5	IT	22MC305 22MC306 22MC307 22MC308 22MC309	**Elective I** Computer Graphics and Multimedia/ Natural Language Processing/ IT Infrastructure Design/ Soft Computing Techniques / CBOT(Computer-based optimization techniques)	3-0-0	3
Total Credit (Theory)					15
Practical					
1	LAB	22MC310	Design and Analysis Algorithms Laboratory	0-0-4	2
2	LAB	22MC311	Python Programming Laboratory	0-0-4	2
3	PROJ	22MC312	Minor Project	0-0-8	4
4	SM	22MC313	Summer Internship	0-0-2	1
Total Credit (Practical)					9
Total Semester Credit					24

Fourth Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	IT	22MC401	Machine Learning	3-0-0	3
2	IT	22MC402	Internet & Web Technology	3-0-0	3
3	IT	22MC403 22MC404 22MC405 22MC407 22MC411 22MC412 22MC413	**Elective II** Internet of Things (IoT)/ Computer Network Security/ Web application Development/ Cloud Computing Data Science Software Testing And Quality Assurance Blockchain Technology	3-0-0	3
Total Credit (Theory)					9
Practical					
1	LAB	22MC408	Machine Learning Laboratory	0-0-4	2
2	LAB	22MC409	Internet & Web Technology Laboratory	0-0-4	2
3	PROJ	22MC410	Major Project / Industrial Training	0-0-24	12
Total Credit (Practical)					16
Total Semester Credit					25

FIRST SEMESTER DETAIL SYLLABUS

2MC101	Data Structure using C (3-0-0)	3 Credits

Course Objective:

1. To impart the basic concepts of data structures and algorithms
2. To understand concepts about searching and sorting techniques
3. To Understand basic concepts about stacks, queues, lists, trees and graphs
4. To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures

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

Introduction to Language: Structure of C Program, Keywords, Identifiers, Primitive Data types, variables, constants, input/output statements. 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

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, Use of Pointers in Inter-function communication via arrays, matrices. Strings handling, Introduction to pointers. Dynamic memory allocation. Structures, Defining structures and Array of Structures, Structure vs Union, self-referential structures, notion of linked list (no implementation).

Module- III: (10 Hrs.)

Abstract Data Types – Definition and Representation, ADT of rational number, ADT of Stack, Data Structure and ADT. Stack and its usages: reversing string, matching parentheses, in fix to postfix. Queue: linear & circular queue. Linked list and its representation: using array, using self-referential structure. Singly, circular and double linked lists. Operations on linked list – Insertion, Deletion, Traversals. Usages of Linked list – insertion sort.

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

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Tree: Definition and Terminologies, child and parent nodes, Sub tree, root, leaf node, internal node, height of a Binary tree. Binary tree traversals. Sorting and Searching: Bubble sort, selection sort quick sort and merge sort. Linear and binary search, Fibonacci search.

Course Outcomes:

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

1. Describe the basics of programming language and its syntax and understand the problem-solving aspect.
2. Design and develop C program to solve different real-life problems efficiently.
3. Analyse and compare different possible solutions.
4. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data

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, 2nd Edition, Prentice Hall of India, 2015.
3. Byron Gottfried, Schaum's Outline of Programming with C, 3rd Edition, McGrawHillBook, 1st July 2017.
4. Data Structures: A Pseudocode Approach with C – Gilberg & Forouzan, 2nd Edition, Cengage, Indian Reprint 2016
5. Data Structures and Program Design in C – Kruse, Leung, 2nd Edition, Pearson,2008

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

22MC102	Computer Organization and Architecture (3-0-0)	3 Credits

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 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.

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Module-I: (10 hrs)

Functional blocks of a computer: CPU, memory, input-output subsystems, Von-Neuman vs Harvard Architecture, Instruction set architecture of a CPU–registers, instruction execution cycle, Basic Operational Concepts, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Module-II (12 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 and non-restoring techniques, signed number representation, fixed and floating-point representations, floating point arithmetic.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Module-III (8 hrs)

Memory system design: semiconductor memory technologies, memory organization.

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

Module-IV (6 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. Programs and

processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

Module-V (6 hrs)

Pipelining: 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" 5th edition Carl Hamacher, Zvonkovranesic, Safwat Zaky, 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.

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

22MC103	Database Management Systems **(3-0-0)**	**3 Credits**

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: (7 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: (7 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: (13 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: (7 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.

Module-5: (10 Hours)

Performance tuning and introduction to NOSQL. Overview of NOSQL databases, measures of query cost, selection operation, sorting, join, Performance Tuning Overview, Basic Tuning Tools, Using Statspack, Identifying Problem SQL Statements, Query Optimization
Influencing the Optimizer (Indexes (B-tree, Bitmap, Function Based indexes and reverse key indexes).

Course Outcome:

1. Designing database and manipulating data for different real life problems
2. Apply SQL queries for retriving 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. Partha Pratim Das, Department of Computer Science & Engineering, IIT Kharagpur 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

22MC104	Mathematics-I(Mathematical foundation of Computer Science)(3-0-0)	3 credit

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*, 6th 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*, 4th Edition, Tata McGraw Hill, 2013. [Chapter – 10(10.1 – 10.3, 10.10), 11(11.1 – 11.5)]
3. E. Kreyszig, Advanced Engineering Mathematics, 10th 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.

22MC105	Communicative English (2-0-0)	2 Credits

Course Objective:

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

Module-I: [8Hrs]

Basics of Communication Skills

Significance of communication, The process and factors of communication (the communication loop), Difference between General and Technical Communication, Verbal communication and its principles, Non- verbal communication, The importance of audience & purpose.

Module-II:[10Hrs]

Basics of English Pronunciation & Soft Skills

Introduction to English pronunciation with the IPA chart, Received Pronunciation, problems of Indian English, Professional presentations, Group Discussion, Interview etiquette, Leadership skills

Module-III:[6Hrs]

Grammar & Vocabulary

Parts of speech &Tense, Voice Change, Direct and Indirect Speech, Concord, Parallelism, Word formation- root words, synonyms, antonyms, homonyms & homophones, Common errors in English Grammar

(N.B. – This unit should be taught by assigning activities to the students in theclass)

Module-IV [6Hrs]

Basics of Reading and Writing Skills

Reading Skill: Types of reading, Sub-skills of reading: Skimming, Scanning, reading comprehension, Writing Skill: Steps to writing, Describing, Defining, Classifying and Providing examples or evidence, Empathetic and Result-Oriented Writing.

Module-V: [10Hrs]

Professional Writing:

Paragraph, Letter, Memos & Circulars, Reports, Proposals, e-mails & CV, Cover Letters, Job Application

Course Outcome:

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 businessdocuments.
3. Gather and prepare information and apply it to persuade or articulate one's own point of view clearly and efficiently.
4. Comprehend the employability market, identify the organizations to get good placements and broaden career plans by developing all-roundpersonality.

Reference Books:

1. Communication Skills by Sanjay Kumar and PushpaLata, Oxford UniversityPress
2. Technical Communication, Principle and Practice by Meenakshi Raman &Sangeeta Sharma, Oxford UniversityPress
3. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw –Hill.
4. Business Communication, Meenakshi Raman &PrakashSingh,Oxford
5. Communication for Management, UrmilaRai and S M Rai,HPH
6. Business and Managerial Communication, Sengupta,PHI
7. Business Communication for Managers, P. Mehra,Pearson
8. Soft Skills K Alex, SChand

Suggested Readings:

1. Manual of English Grammar and Composition. J.C. Nesfield ForgottenBooks
2. Practical English Usage. Michael Swan.OUP.
3. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford UniversityPress
4. A Course in English phonetics by T.R. KANSAKAR, ORIENT LONGMENPress.
5. A Communicative Grammar of English, Leech, Geoffrey & Jan Svartvik,,Longman

22MC107	Data Structure Laboratory (0-0-4)	2 Credits

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.

22MC108	Database Management Systems Laboratory (0-0-4)	2 Credits

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

(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

22MC110	Seminar (0-0-1)	1 Credits

SECOND SEMESTER DETAIL SYLLABUS

22MC201	Object Oriented Programming using JAVA (3-0-0)	3 Credits

Course Objective:
Learn the syntax, semantics and idioms of the Java programming language. Gain confidence in object-oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries.

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 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.

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, Registering Driver, Creating Connection, Executing SQL query using Statement, PreparedStatment. ResultSet methods.

Module V **(10 Hours)**

Event Handing: 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.

Course Outcome:

After completing this course, students will be able to:

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.

Suggested Books and Materials :

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, Goran Lochert

Suggested Books and Reading Materials:

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, Goran Lochert

Course Name	Programming in JAVA
Course Link	https://onlinecourses.nptel.ac.in/noc21_cs03/preview
Course Instructor	Prof. Debasis Samanta Dept. Computer Science and Engineering from Indian Institute of Technology, Kharagpur

22MC202	Computer Networks (3-0-0)	3 Credits

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, Protocols and standards, OSI Reference model, TCP/IP Protocol.

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

(TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and FiberOptic Cable) and unguided media (wireless), Switching: Circuit Switched Network, 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, CDMA). Wired LANs (Ethernet): Traditional Ethernet, Fast Ethernet, Gigabit Ethernet.

Module – III **(06 Hrs)**

Wireless LANs: IEEE 802.11 and Bluetooth.

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 **(06 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).

Module – V **(04 Hrs)**

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 tranmission with the associated protocols and mechnism of channel access methods.

3. Understand and apply host addressing logic & subneting 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, 5thEdition(2013).
2. Computer Networks, A. S. Tannenbum, D. Wetherall, Pearson Education, 5thEdition(2014).
3. Data and Computer Communications, William Stallings, Pearson Education, 10thEdition(2018).
4. Computer Networking, A Top-Down Approach, James F. Kurose, Keith W. Ross, Pearson publication, 6thEdition(2017).
5. http://www.nptelvideos.in/2012/11/computer-networks.html, Prof. SujoyGhosh, IIT, Kharagpur.

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

Course Name	Introduction to Computer Networking
Course Link	https://www.classcentral.com/course/stanford-openedx-introduction-tocomputer-networking-1578

Course Instructor	Prof. Philip Levis and Professor Nick McKeown, Stanford University

22MC203	Operating Systems (3-0-0)	3 Credits

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: **(8 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: **(6 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

Module- V: **(6 Hrs.)**

I/O System: I/O System Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Request to Hardware Operation

Case studies on Linux: Basic Concepts; System Administration-Requirements for Linux System Administrator, setting up a LINUX Multifunction Server, Domain Name System, Setting up Local Network Services.

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, 6th 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, 4th Edition, Pearson Education, 2014

5. Naresh Chouhan: Principles of Operating System, Oxford University Press.

Web Courses/Online courses:

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

22MC204	Software Engineering (3-0-0)	3 Credits

Course Objective:

1. Explain different software development paradigm
2. Demonstration of UML diagrams and its pros and cons
3. Explain different metrics used in project management
4. Explain different software engineering practices.

Module-I: **(8 Hrs.)**

Introduction, Introduction to Software Development processes, Agile software development: Agile methods, Plan-driven and agile development, Extreme programming, Agile Process model: Adoptive software development, scrum, crystal, Agile modelling, Agile unified process.

Module-II: **(6 Hrs.)**

Requirements engineering: Functional and non-functional requirements: The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management

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

Object-oriented design using UML: Analysis and Design: Concepts, Classes and Objects. Relationships Among Objects. Inheritance and Polymorphism, Design Concepts, Design Notation and Specification, Design Methodology, Dynamic Modelling, Functional Modelling, Defining Internal Classes and Operations, Design patterns. System modelling: Context models, Interaction models, Structural models, Behavioural models Model-driven engineering

Module-IV: **(6 Hrs.)**

Architectural design: Architectural design decisions, Architectural views, Architectural patterns, Application architectures, Design and implementation, Testing: Introduction to software testing, verification and validation, unit testing, integration testing, system testing. Software Maintenance.

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

Project management: introduction to Risk management, managing people, Teamwork, Project planning, Software pricing, Plan-driven development, Project scheduling,

Estimation techniques, Quality management, Software measurement and metrics Introduction to Advanced Software Engineering concepts: Software reuse, Component based software engineering, Distributed software engineering, Service-oriented architecture, Embedded software, Aspect-oriented software engineering

Course Outcome:

1. To understand basic concepts of software engineering and outline the features of different lifecycle models.
2. To explain the principles involved in gathering and validating software requirements.
3. To make use of suitable models through analysis of requirements and arrive at an appropriate software design.
4. To appreciate the quality assurance procedures during software development and able to handle the post implementation issues of software project and software maintenance practices.

Text Book:

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	https://nptel.ac.in/courses/106105182/
Course Instructor	PROF. RAJIB MALL Dept. of Computer Science and Engineering, IIT Kharagpur

Course Name	SOFTWARE ENGINEERING
Course Link	https://nptel.ac.in/courses/106/101/106101061/
Course Instructor	Prof.Rushikesh K Joshi, Prof.UmeshBellur,Prof. N.L. Sarda, IIT Bombay,

22MC205	Mathematics-II (Probability and Statistics) (3-0-0)	3 Credit

Course Objective

The course should enable the students to:

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

SYLLABUS

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.

TEXT BOOKS

1. R. E. Walpole, S. L. Myers, and K. Ye, *Probability and statistics for engineers and scientists*, 8th 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*, 10th revised edition, Sultan Chand & Sons. [Chapter- **10**(10.1 – 10.7)]

REFERENCE BOOKS

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

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.

22MC210	Environmental Science (3-0-0)	0 Credits

Course Objective:

2. To give students an understanding of how science and the scientific method work to address environmental problems.
3. Students will learn about the interaction of human society (urban sprawl, energy use/generation, resource consumption and economics) with the Earth's systems
4. students will learn about air pollution and global climate change.students will apply their knowledge for efficient environmental decision-making, management and sustainable development.
5. Students will prepare for successful career in environmental departments, research institutes, industries etc.

Module – I

Ecological Concepts and Natural Resources: Ecological perspective and value of environment. Ecosystem: Concept, structure & Function of ecosystem; Energy cycle, Food Chain, & Food Web; Ecological pyramid, types; Biodiversity; Ecological Succession: Type of ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem. Geochemical Cycle: Water cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, etc., Sedimentation Cycle: Sulphur cycle, phosphorous cycle; Environmental gradients, Tolerance levels of environment factor, Indian Environmental Law; Environmental Auditing.

Module – II

Water quality standards and parameters, Assessment of water quality, Organic content parameters, Types, sources and consequences of water pollution; Ground water Contamination, Waste Water Treatment: DO and BOD of Waste water; Waste water treatment process: pre-treatment, primary treatment, (Sedimentation, equalization and neutralization etc.), secondary treatment (Activated sludge technique and Trickling filter) tertiary treatment methods (Evaporation, Ion exchange, Adsorption, Electrodialysis, Electrolytic recovery, reverse osmosis).

Module – III

Air Pollution : Air pollution and pollutants, criteria pollutants & non-criteria pollutants, Acid deposition, Global climate change –greenhouse gases, Ozone layer Depletion, Smog; Industrial Air Emission Control: Flue gas desulphurization, NOx removal, Fugitive emissions. Methods for control of particulate air pollutants (Mechanical device, Fabric Filtration, scrubber, Electrostatic precipitator)

Module – IV

Solid Waste Management Source classification and composition of MSW: properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling,

Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment of hazardous waste: Incinerators, Inorganic waste treatment, handling of treatment plant residue. Waste minimization techniques.

Noise Pollution: Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

Text Book

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering & Safety by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack

Reference Books

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A.Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra

An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.

22MC206	Object Oriented Programming using JAVA Laboratory	2 Credits

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.

22MC207	Computer Network Laboratory (0-0-4)	2 Credits

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 Netam 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: n0 – n2, n1 – n2 and n2 – n3. Apply TCP agent between n0 – n3 and UDP agent between n1 – n3. 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.

22MC208	Operating System Laboratory (0-0-4)	2 Credits

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 Dinning 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.

Suggested Books:

1. Jain S,Pillai V, Kratika, Rai A, Basics of OS, UNIX and SHELL Programming, BPB Publication, 2017
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System concepts, 8th edition, Wiley-India, 2009
3. Andrew S. Tanenbaum: Mordern Operating Systems, 4th Edition, Pearson Education, 2014.

22MC209	Personality and Soft Skill Development (0-0-4)	2 Credits

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.

22MC301	Design and Analysis of Algorithms (3-0-0)	3 Credits

Course Objective:

1. Given a English language problem description define the problem precisely with input/output requirements, examine its inherent complexity and develop a generic or set of initial solutions and justify their correctness.
2. Given an algorithm description, analyse the time and space complexity of the algorithm in the worst case, average case, and amortized scenario as needed in terms of asymptotic order of complexity.
3. Given a problem definition explore different alternative algorithmic solutions, compare them with respect to time and space complexity and choose the design scheme and /or design parameter and data structure appropriately to obtain the best possible choice(s) that can be converted to an executable program.
4. Examine and prove whether a problem is of polynomial complexity, hard (np complete) or otherwise and develop optimal and approximate algorithm for them as applicable.

Course Outcome:

CO	Outcomes
1.	Analyze the time and space complexity of a given algorithm in best, worst & average case scenario and represent using asymptotic notation.
2.	Use various design paradigms (Greedy, Divide-and-Conquer, Dynamic Programming, Branch-and-Bound and Backtracking) while designing algorithm for a given problem statement.
3.	Understand the major graph & string matching algorithms and apply to engineering problems, when appropriate.
4.	Recognize problems of the classes P, NP & NP-Complete and understand concepts of Approximation Algorithm.

Module-I: **(12 Hrs.)**

Introduction to problems and algorithms, Mathematics for algorithm analysis , Insertion sort Analysing algorithms, Designing of algorithms, Asymptotic notation Standard notations and common functions, Recurrence relations, The substitution method, The recursion-tree method, The master method, Divide and conquer: Min-Max Heap, Priority queue, Heapsort , Quicksort, Merge Sort, Sorting in Linear Time: Lower bounds for sorting: Counting sort, Radix sort, Bucket sort, Fast Fourier transform ,

Finding the convex hull: Graham Scan, Finding the closest pair of points

Module-II: **(8 Hrs.)**

Greedy method: Elements of the greedy strategy, Huffman codes, task-scheduling problem, Fractional Knapsack problem, Coin change problem, Dynamic programming: Assembly-line Scheduling, Matrix-Chain Multiplication, Longest Common Sub-sequence (LCS), 0/1 Knapsack problem, Rod Cutting problem

Module-III: **(6 Hrs.)**

Graph algorithms: Basic Definitions and Application, Representations of graphs, Breadth-first search and Depth-first search, Data Structures for Disjoint Sets, strongly connected components, Minimum Spanning Trees: The algorithms of Kruskal and Prim

Module-IV: **(6 Hrs.)**

Single-Source Shortest Paths: The Bellman-Ford algorithm, Dijkstra's algorithm, All Pairs Shortest Paths-Shortest paths and matrix multiplication, The Floyd-Warshall algorithm

String Matching: The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm

Module-V: **(8 Hrs.)**

Network Flow: Flow networks, The Ford-Fulkerson method, Maximum bipartite matching

Backtracking – n-Queen problem – Hamiltonian Circuit Problem – Subset Sum Problem.

Branch and Bound – LIFO Search and FIFO search – Assignment problem – Knapsack Problem, NP-Completeness: Classes P and NP, NP-complete problems.: Reduction of 3SAT to Subset Sum, Approximation Algorithm for TSP

Suggested Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, MIT Press/McGraw-Hill, 2009.
2. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2007.
3. SanjoyDasgupta, Christos H. Papadimitriou and Umesh V. Vazirani, Algorithms, McGraw-Hill, 2008.
4. Jon Kleinberg and ÉvaTardos, Algorithm Design, Addison-Wesley/PEARSON EDUCATION-2006.
5. S. Sridhar, ―Design and Analysis of Algorithms‖, Oxford university press, First Edition, 2015.

Course Name	DESIGN AND ANALYSIS OF ALGORITHMS
Course Link	https://nptel.ac.in/courses/106101060/
Course Instructor	Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan, IIT Bombay

Course Name	DESIGN AND ANALYSIS OF ALGORITHMS
Course Link	https://nptel.ac.in/courses/106106131/
Course Instructor	Prof. Madhavan Mukund, Chennai Mathematical Institute

Course Name	DESIGN AND ANALYSIS OF ALGORITHMS
Course Link	https://online.stanford.edu/courses/cs161-design-and-analysis-algorithms
Course Instructor	Reyna Hulett, CS161, Stanford School of Engineering,

22MC302	Data and Web Mining (3-0-0)	3 Credits

Course Objectives

1. Identify the scope and necessity of Data Mining and Knowledge Discovery.
2. To understand various tools of Data Mining and their techniques to solve the real time problems.
3. To develop ability to design various algorithms based on data mining tools.
4. To develop further interest in research and design of new Data Mining techniques.

Course Outcomes

1. Understand warehousing architectures and tools for systematically organizing large databaseand use their data to make strategic decisions.Understand KDD process for finding interesting pattern from warehouse.
2. Remove redundancy and incomplete data from the dataset using data preprocessing methods.
3. Characterize the kinds of patterns that can be discovered by association rule mining.
4. Discover interesting patterns from large amounts of data to analyze for predictions and classification

Module I **(10 Hrs.)**

Knowledge Discovery in Databases (KDD) process: data integration, mining, and interpretation of patterns in large collections of data. Overall Architecture, Data Warehouse Database Sourcing, Data pre-processing techniques: Acquisition, Clean-up & Transformation Tools, Metadata data mining techniques for classification, regression, clustering, deviation detection, and association analysis; and evaluation of patterns mined from data.

Module II **(10 Hrs.)**

Data Warehousing Component, Defining Features, data warehouses and data marts, overview of the components, metadata in the data warehouse. OLAP in the Data Warehouse: Demand for Online analytical processing, need for multidimensional analysis, OLAP definitions and rules, OLAP characteristics, major features, dimensional analysis, hypercube. Drill-down and roll-up, slice-and-dice or rotation, OLAP models, overview of MOLAP model, ROLAP model, ROLAP versus MOLAP.

Module III **(12 Hrs.)**

Data Mining Basics: What is Data Mining, Data Mining Defined, The knowledge discovery process, OLAP versus data mining, data mining and the data warehouse, Major Data Mining Techniques, Cluster detection, decision trees, memory-based reasoning, link analysis, neural networks, Data Mining Applications, Benefits of data mining in industry, banking and finance.

Module IV **(6 Hrs.)**

Web mining: classifying web pages, extracting knowledge from the web, mining the World Wide Web, Spatial Data Mining, Multimedia Data Mining, Text Mining.

Text Book and Materials:

1. Jiawei Han, Micheline Kamber, and Jian Pei, “Data Mining Concepts and Techniques”, Third Edition, Elsevier.

2. Data Warehousing, Data Mining & OLAP by Alex & Stephen, McGraw Hill.

3. Vikram Pudi & P. Radha Krishna, Data Mining, Oxford University Press.

4. Reema Thareja, Data Warehousing, Oxford University Press.

Course Name	Data and Web Mining
Course Link	https://nptel.ac.in/courses/106/105/106105174/
Course Instructor	PROF. PABITRA MITRA Department of Computer Science and Engineering, IIT Kharagpur

Course Name	Data and Web Mining
Course Link	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
Course Instructor	

22MC303	Python Programming (3-0-0)	3 Credits

Course Objective:

1. To acquire programming skills in core Python.
2. To acquire Object Oriented Skills in Python
3. To develop the skill of designing Graphical user Interfaces in Python
4. To develop the ability to write database applications in Python

Course Outcomes:

1: Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.

2: Express proficiency in the handling of strings and functions. Understand and determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.

3: Identify the commonly used operations involving file systems and regular expressions.

4: Understand and implement inheritance, exceptions and database handling

Module-I

Python: Features of Python , Installing Python for windows and setting up paths, writing and Executing of a python programs, Python Virtual machine, Frozen binaries, Comparison between C, Java and python , Comments , Docstrings ,How python sees variables, Data types in Python, built in types, sequences in python, sets, literals in Python, user defined data types, identifiers & reserved words, Naming convention in python,

Module-II

various Operators in Python, Input & Output, Control statements, if statements, while loop, for loop, infinite loop, nested loop ,else suit, break, continue, pass ,assert, return statements, command line arguments.

Arrays in python, advantages using arrays, creating arrays, importing the array module, indexing and slicing on arrays, Processing the arrays, Comparing arrays.

Strings in Python, Creating strings, Length of a string, Indexing in strings, Slicing strings, Concatenation and Comparing strings,Finding SubStrings, Replacing a String.

Module-III

Functions in Python, define a function, calling a function, return from function, pass by object Reference, Positional arguments, Default arguments, Recursive functions.

Introduction to OOP, features of OOP, creating classes, the self-variable, constructor, types of variables, namespaces, types of methods.

Module-IV

Inheritance: Define inheritance, types of inheritance, constructors in inheritance, overriding super class constructors & methods, the super() method, MRO

Polymorphism: Duck typing philosophy of Python, operator overloading, method overriding, interfaces in python

Exceptions: Errors in a python program, Exceptions, Exception handling, Types of Exceptions, The Exception block, the assert statement, user defined exceptions

Python Database Connectivity: DBMS, types of databases used with Python, installation of MySQL database, setting path, verifying MySQL , installing MySQL connector, Working with MySQL database, Using MySQL from python, retrieving rows ,deleting rows, updating rows in a table.

Text Books

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011.
2. Core Python Programming, Dr. R. Nageswar Rao , Dreamtech Press
3. Python Programming for Absolute Beginners, Michael Dawson, CENGAGE Learning

Reference Books

1. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012

Course Name	Python Programming
Course Material Link	Python Tutorial/Documentation www.python.or 2015
Course Material Link	http://docs.python.org/3/tutorial/index.html
Course Material Link	http://interactivepython.org/courselib/static/pythonds

22MC304	Artificial Intelligence (3-0-0)	3 Credits

Course Objective:

1. To learn the concepts of Artificial Intelligence
2. To learn the methods of solving problems using Artificial Intelligence
3. To introduce the concepts of Expert Systems and it design procedure

Course Outcome:

1. Ability to comprehendAI&EStoanalyzeandmaprealworldactivitiestodigitalworld
2. Ability to identify problems that are amenably solved by AI methods
3. Ability to design and carryout an empirical evaluation of different AI algorithms

Module-1:[12Hrs]

Intelligence and AI, Agents, Model of different types of agents: reactive, deliberative, goal-driven, utility-driven, and learning agents, Environment, Properties of Environment, State Space, Knowledge, Rationality, and TuringTest. Search Techniques definition and importance, uninformed search–DFS, BFS, iterative deepening, iterative broadening, depth limited search, Issues In Design Of heuristics, Best First search, A* and AO* search, Hill climbing, Simulated Annealing, ConstraintSatisfactionProblem,8-puzzle problem, Cryptarithmetic Problem.

Module-2:[10Hrs]

Adversarial Search, Game Playing, minimax search,alpha-beta pruning. Knowledge Representation in AI,Logic-propositional, predicate,FirstOrder Logic .Normal forms. Modus Ponens & Modus Tollens, Theorem Proving, Principle of Resolutions, Non-Monotonic Reasoning. Semantic Net Frame.

Module-3:[12Hrs]

Planning And Its Importance. Classical Partial order planning, Conditional Planning. Uncertainty, type of uncertainty, Probabilistic Reasoning-joint distribution reasoning, Bayesian networks, learning, explanation based learning, induction learning-Decision Tree, statistical learning-Bayesian Learning, expectation maximization, hidden Markov model, closed world problems.

Module-4:[6Hrs]

Expert Systems–Design Techniques, components, Problem And Knowledge Domain, Knowledge Engineering Approach, error in design of expert system, life cycle of expert system, MYCIN and dendral–an expert system.

Textbooks:

1. ArtificialIntelligence–Knight&Rich, McGrawHill, 3rdEdition.
2. Principles of Artificial Intelligence –N.J.Nilson, 2ndEdition, NarosaPublishing.

Reference Books:

1. ArtificialIntelligenceAModernApproach–Russel&Norvig,2ndEdition,Pearson.
2. IntroductiontoArtificialIntelligenceandExpertSys–D.W.Patterson,PrenticeHall.
3. Expert System: Principle and programming-JosephGiarratano,GaryRiley
4. NPTEL course-https://nptel.ac.in/courses/106106126/

Digital Learning Resources

Course Name	Artificial Intelligence
CourseLink	https://nptel.ac.in/courses/106/105/106105079/
Course Instructor	Prof.P.Dasgupta,IITKharagpur

22MC305	Computer Graphics and Multimedia (3-0-0)	3 Credits

Course Objective:

1. To study the primary objective of this course is to learn the basic principles for representation of the geometric objects in the 2D and 3D coordinates. Utilize the computer system and methods
2. To learn the implement the algorithms and techniques necessary to produce geometric objects in 2D and 3D space illustrations.
3. To study the geometric optics necessary to determine how light bounces off surfaces. Shading algorithms to determine how a surface should be shaded to produce realistic illustrations. Curves and surfaces methods for rendering and shading curved objects.
4. The students will design and implement a substantial computer graphics system/project to represent some complex illustrations with the help of graphics system

Course Outcome:

1. Student will understand the basic principles for representation of the geometric objects in the 2D and 3D coordinates.
2. Student will learn the implement the algorithms and techniques necessary to produce geometric objects in 2D and 3D space illustrations.
3. Student will understand Shading algorithms to determine how a surface should be shaded to produce realistic illustrations. Curves and surfaces methods for rendering and shading curved objects.
4. The students will be able to design and implement a substantial computer graphics system/project to represent some complex illustrations with the help of graphics system.

Module-I: **(8 Hrs.)**

Overview of Graphics System: Video Display Units, Raster-Scan and Random Scan Systems, Graphics Input and Output Devices. Output Primitives: Line drawing Algorithms: DDA and Bresenham's Line Algorithm, Circle drawing Algorithms: Midpoint Circle Algorithm and Bresenham's Circle drawing Algorithm.

Module-II: **(6 Hrs.)**

Two-Dimensional Geometric Transformation: Basic Transformation (Translation, Rotation, Scaling) Matrix Representation, Composite transformations, Reflection, Shear, Transformation between coordinate systems. Two-Dimensional Viewing: Window-to-View Port Coordinate Transformation.

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

Clipping: Line Clipping (Cohen-Sutherland Algorithm) and Polygon Clipping (Sutherland-Hodgeman Algorithm), Aliasing and Antialiasing, Half Toning, Thresholding, Dithering. Polygon Filling: Seed Fill Algorithm, Scan line Algorithm. Two-Dimensional

Object Representations: Spline Representation, Bezier Curves, B-Spline Curves. Fractal Geometry: Fractal Classification and Fractal Dimension.

Module-IV: (8 Hrs.)

3D Geometric and Modelling Transformations: Translation, Rotation, Scaling, Reflections, shear, Composite Transformation. Projections: Parallel Projection, Perspective Projection.

Visible Surface Detection Methods: Back-Face Detection, Depth Buffer, A- Buffer, Scan- Line Algorithm, Painters Algorithm.

Module-V: (8 Hrs.)

Illumination Models: Basic Models, Displaying Light Intensities. Color models: properties of light, XYZ, RGB, YIQ and CMY color models, Surface Rendering Methods: Polygon Rendering Methods: Gouraud Shading, Phong Shading. **Computer Animation:** Types of Animation, Key frame Vs. Procedural Animation, Methods of Controlling Animation, Morphing. Introduction to Virtual Reality and Augmented Reality.

Suggested Books:

1. Computer Graphics, C version; D. Hearn and M. P. Baker; Pearson Education, 2nd Edition, 2002
2. Computer Graphics Principle and Practice, J.D. Foley, A. Dam, S.K. Feiner, Addison Wesley, 4th Edition, 2014.
3. Procedural Elements of Computer Graphics, David Rogers, TMH. 1998

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

MOOC courses:

https://www.coursera.org/learn/interactive-computer-graphics by Takeo Igarashi (Professor) Department of Computer Science, Graduate School of Information Science and Technology, University of Tokyo.

22MC306	Natural Language Processing (3-0-0)	3 Credits

Course Objectives

1. Developing ability to syntactically, semantically and pragmatically understand Natural Language data for rule based processing.
2. Learn how Natural Language can also be analyzed statistically.
3. And to learn nuances of Natural Language based machine learning.

Course Outcome:

1. Provides a modern and statistical perspective on natural language processing.
2. Enable the student to: acquire fundamentals of language technology; understand, implement, and apply state-of-the-art techniques to novel problems involving natural language data
3. Able to read and understand current research literature.

Module:I

[10 Hrs]

Introduction, Regular Expression, Text Normalization, Edit Distance, N-gram Language Model, Data Generalization and Smoothing, Kneser-Ney Smoothing.

Lexical Semantics, Vector Semantics, Words and Vectors, Similarity Metrics Measures, Term Frequency Inverse Document Frequency, Word Embedding and its Semantic properties, Word2vec Models, Parts-of-Speech, HMM based POS Tagging, Sequence Processing.

Module:II [10 Hrs]

Parsing: Context Free Grammar, Treebanks, Lexicalized Grammars. Ambiguity Resolution, Statistical/Probabilistic Parsing, PCFG, Evaluating Parser, Dependency Parsing, Dependency Relations and Formalisms, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing, Representation of Meaning, Model-Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics.

Module III [10 Hrs]

Information Extraction, Named Entity Recognition, Relation Extraction, Time Extraction, Event Extraction, Template Filling, Semantic Role Labeling, Diathesis Alterations, The Proposition Bank, FramNet, Selection Restrictions, Sentiment Analysis: Defining Emotions, Creating Affect Lexicons, Semi-supervised Induction of Affect Lexcons, Sentiment Recognition, Affect Recognition, Connotation Frames.

Module: IV

[10 Hrs]

Extraction based Text Summarization, Abstraction based Text Summarization, Coreference Resolution, Discourse Analysis, Machine translation, Information Retrieval based Question Answering, Knowledge based Question Answering, Dialog Systems, Chatbots.

Text Books:

1. Dan Jurafsky and James H. Martin. Speech and Language Processing, Prentice-Hall. (3rd Edition)
2. James Allen. Natural Language Understanding, Pearson.
3. Chris Manning and Hinrich Schuetze. Foundations of Statistical Natural Language Processing, MIT Press.
4. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning, MIT Press.

Online Materials

1. Natural Language Processing, Skills gain - NLP, Tenserflow, Dialog Systems, Deep Learning.
2. Natural Language Processing using Python, Skills gain - NLP, Machine Learning specific NLP models.
3. Advanced NLP using Deep Learning, Skills gain - Deep Learning, Advanced NLP.
4. NLP Notes by Jacob Eisenstein.

Digital Learning Resources

Course Name	**Natural Language Processing**
Course Link	NPTEL :: Computer Science and Engineering - NOC:Natural Language Processing
Course Instructor	Prof. Pawan Goyal, IIT Kharagpur

Course Name	**Natural Language Processing**
Course Link	NPTEL :: Computer Science and Engineering - Natural Language Processing
Course Instructor	Prof. Pushpak Bhattacharyya, IIT Bombay

22MC307	IT Infrastructure Design (3-0-0)	3 Credits

Course Objective

1. To develop a comprehensive knowledge of the functionality of networking hardware.
2. To acquire the skills to solve business problems that require IT solutions.
3. To develop the competency to investigate inter-organization and intra-organization communications problems and propose a viable technology solution.

Course Outcome

1. Identify, evaluate and select an integrated IT infrastructure (hardware, software, architectures, and services) to best fulfill a given set of organizational requirements.
2. Critically analyze an existing IT infrastructure, identify its strengths and weaknesses, and develop a roadmap for future evolution.
3. Critically assess an emerging technology and demonstrate how it can be used to enhance a firm's competitive position.
4. Analyze and appraise the technical, managerial, security, regulatory, and ethical issues associated with the acquisition, deployment, and management of modern IT infrastructures and emerging technologies.

UNIT I

Overview of Analysis, Architecture, and Design Processes: Process Components, Tactical and Strategic Significance, Hierarchy and Diversity, Importance of Network Analysis, Model for Network Analysis, Architecture, and Design.

A Systems Methodology, System Description, Service Description, Service Characteristics: Service Levels, System Components and Network Services, Service Requests and Requirements, Service Offerings, Service Metrics.

Performance Characteristics: Capacity, Delay, RMA, Performance Envelopes, Network Supportability

Network Architecture: Component Architecture –Routing, Network Management, Performance, Security.

Architectural models: topological, flow model, Functional model.

UNIT II

Enterprise LAN Design: Ethernet Design Rule. 100 Mbps Fast Ethernet Design rules, gigabit Ethernet Design Rules, 10 Gigabit Ethernet Design rules, 10GE Media types

Understanding Working of Repeater, hub, Bridge, routers, Layer2/3 Switch,

Campus LAN Design Best Practice, Server Farm Design, Campus LAN QoS consideration, Multicast Traffic Consideration

UNIT III

Routing Protocol Characteristics, Static Versus Dynamic Route Assignment, Interior Versus Exterior Routing Protocols, Distance-Vector Routing Protocols, EIGRP, Link-State Routing Protocols, Distance-Vector Routing Protocols Versus Link-State Protocols, Hierarchical Versus Flat Routing Protocols, Classless Versus Classful Routing Protocols, Administrative Distance. Routing Protocol Metrics and Loop Prevention: Hop Count, Bandwidth, Cost, Load, Delay, Reliability, Maximum Transmission Unit,

Routing Loop-Prevention Schemes: Split Horizon, Poison Reverse, Counting to Infinity, Triggered Updates

RIPv2: Authentication, MD5 Authentication, RIPv2 Routing Database, RIPv2 Message Format, RIPv2 Timers, RIPv2 Design, RIPv2

RIPng: RIPng Timers, Authentication, RIPng Message Format, RIPng Design

OSPF: Metric, Adjacencies and Hello Timers, OSPF Areas,OSPF Router Types, OSPF DRs, LSA Types

EIGRP: Components, Neighbor Discovery and Recovery, Timers, Packet Types, Design

UNIT IV

Server-Centric IT architecture and its Limitations, Storage-centric IT Architecture and its Advantages.

Intelligent Disk Subsystems: Architecture, Storage Virtualization using RAID, RAID levels,

I/O Techniques: SCSI, Fibre Channel Protocol stack, Fibre Channel SAN, IP Storage.

UNIT V

Enterprise Wireless LAN Architecture: Components of Centralize Architecture: understanding 802.11X standards. WLAN technologies (Narrow Band, Spread Spectrum, FHSS, DSS) and topologies,

Wireless Network Components: Access Point and NICs, Router etc; WLAN enterprise design, WLAN performance, WLAN monitoring and troubleshooting, WLAN security. Intra and inter controller roaming.

Text Books:

1. Network Analysis, Architecture, and Design, James D. McCabe, 3rd Edition, Morgan Kaufman

2. CCDA Cisco official Guide

3. Storage Networks explained by Ulf Troppen, Wiley.

4. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley, India

22MC308	Soft Computing techniques (3-0-0)	3 Credits

At the end of the course the student should be able to

1. Learn about soft computing techniques and their applications
2. Analyze various neural network architectures
3. Understand perceptrons and counter propagation networks.
4. Define the fuzzy systems
5. Analyze the genetic algorithms and their applications.

Course outcomes:

1. Learn about soft computing techniques and their applications
2. Analyze various neural network architectures
3. Understand perceptrons and counter propagation networks.
4. Define the fuzzy systems and Analyze the genetic algorithms and their applications

UNIT 1:

Introduction: Introduction to soft computing, application areas of soft computing, classification of soft computing techniques, structure & functioning of biological brain & Neuron, and concept of learning/training. Model of an Artificial Neuron, transfer/activation functions, perceptron, perceptron learning model, binary & continuous inputs, linear separability

UNIT 2:

Multilayer Neural Networks: Feed Forward network - significance, training, loss function, Back-Propagation algorithm, convergence & generalization, momentum, applications. Feedback network -Hopfield Nets: architecture, energy functions, training algorithms & examples, competitive learning, self-organizing maps. Introduction to CNN and RNN network

UNIT 3:

Fuzzy Systems: fuzzy set theory, fuzzy sets and operations, membership functions, concept of fuzzy relations and their composition, concept of fuzzy Measures. Fuzzy logic: fuzzy rules, inferencing. Fuzzy Control system: selection of membership functions, Fuzzyfication, rule based design & inferencing, defuzzyfication, applications of fuzzy system.

UNIT 4:

Fundamentals of Genetic Algorithms: Genetic Algorithms: History, Basic Concepts, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction. Genetic Modeling: Inheritance Operators, Cross Over, Inversion, And Deletion, Mutation Operator,

Bit-Wise Operators, Bit-Wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithms, Hybrid Systems, NN & FL & GA Hybrids

Books Recommended

1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications

2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication

3. Bose, Neural Network fundamental with Graph , Algo.& Appl, TMH Kosko: Neural Network & Fuzzy System, PHI Publication

4. Klir & Yuan ,Fuzzy sets & Fuzzy Logic: Theory & Appli.,PHI Pub. Hagen, Neural Network Design, Cengage Learning

22MC309	CBOT (Computer Based Optimization Techniques) (3-0-0)	3 Credits

Course Objective:

1. Introduce the use of computational optimization techniques & algorithms for effective decision making.
2. To formulate & model, solve and check the feasibility of the model of real world problems.
3. To understand the reality of a problem by generating an empirical optimal model in transportation and assignment problems.
4. To take decisions involved in queuing lines.
5. To handle project planning effectively.

Course Outcomes:

The students will be able to know:

1. Realization of the importance of optimization in industrial management, financial management and basic concepts of mathematics to formulate an optimization problem.
2. Realization of the usefulness of special linear optimization techniques in Transportation and Assignment problems.
3. Decision making, analyses and appreciate variety of performance measures for various optimization problems.
4. Manages project risk, including identifying, analyzing and responding to risk. We can reach nearer to optimality by simulation techniques.

Module – I: [10 Hours]

Introduction to Linear Programming Problem: Formulation of LPP, Solution of LPP by Graphical, Simplex Algoritm, Big-M Method, Duality, Dual Simplex Method, Special cases in Simplex Method application, Revised Simplex Algorithm.

Module – II: [10 Hours]

Sensitivity Analysis on (resources and coefficients of objective function), Integer Linear Programming problem, Branch and Bound Technique. Transportation Problem: Mathematical Formulation, Initial basic feasible solution by North West Corner Cell Method, Least Cost Cell Method & Vogel's Approximation Method, Degeneracy, Test of Optimality by MODI Method. Assignment Problem: Mathematical Formulation, Hungarian Algorithm Minimization and Maximization Problems.

Module – III: [6 Hours]

Game theory: Introduction, Terminologies, Game with pure and mixed startegies, Dominance properties, Graphical method, Sequencing.

Module – IV: [7 Hours]

Queueing Theory: Introduction,Terminologies, Markovian Queueing Models with single sever, multiservers, finite, & infinite capacity.

Module – V: [7 Hours]

Project Management: Terminology, Optimal Scheduling a Project with CPM/ PERT, Optimal Crashing of Project Activities.

Simulation: Random variable, Monte-Carlo Simulation, Generation of random numbers.

Test Books:

1. Hamdy A. Tahy, Operations Research an Introduction, 8th Edition, PHI Private Ltd.

2. Ravindran Philips Solberg, Operations Research Principles and Practice, 2nd Edition, Wiley India Private Ltd.

Reference Books:

1. P. K. Gupta and D. S. Hira, Operations Research, S CHAND, Fifth Edition.

2. Hiller Lieberman, Operations Research, 8th Edition, TMH 2005.

3. R Panneerselvam, Operation Search, PHI.

4. S. I. Gass, Linear programming methods and applications, 5th edition, Boyd and Fraser Publishing Company, Danvers Massachusetts.

--------- N.B: The course is of 3 credits with 4 contact hours ---------

22MC310	Design Analysis and Algorithms Laboratory (0-0-4)	2 Credits

Lab Assignments

1. Insertion Sort/ Selection Sort
2. Divide and Conquer: Fibonacci search/Binary search
3. Divide and Conquer: Merge Sort/Quicksort/Heap Sort
4. Divide and Conquer: Convex hull/Finding closet pair
5. Dynamic Programming: MCM/LCS
6. Dynamic Programming: Rod Cutting problem /Assembly line Scheduling
7. Greedy method: Activity Selection/Huffman Coding
8. Graph Search: BFS/DFS
9. Graph Greedy MST: Kruskal/Prim's
10. Graph Greedy Shortest Path: Bellman ford/Dijkstra
11. Rabin Karp string matching algorithm/Subset Sum problem using Branch and Bound

Prerequisite: Each student should have a good knowledge on basic data structures like Stack, Queue, List, Heap, Matrix

22MC311	Python Programming Laboratory (0-0-4)	2 Credits

Lab Objectives:

➢ To write, test, and debug simple Python programs.

➢ To implement Python programs with conditionals and loops.

➢ Use functions for structuring Python programs.

➢ Represent compound data using Python lists, tuples, and dictionaries.

➢ Read and write data from/to files in Python.

2. Lab Outcomes:

Upon completion of the course, students will be able to

➢ Write, test, and debug simple Python programs.

➢ Implement Python programs with conditionals and loops.

➢ Develop Python programs step-wise by defining functions and calling them.

➢ Use Python lists, tuples, dictionaries for representing compound data.

➢ Read and write data from/to files in Python

Week - No	S.No/Program .No	List of Programs
1	1	A) Create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6) clear()
	2	B) Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get() 4)change values 5) use len()
	3	C) Create a tuple and perform the following methods 1) Add items 2) len() 3) check for item in tuple 4)Access iems
2	1	A) Write a python program to add two numbers.
	2	B) Write a python program to print a number is positive/negative using if-else.
	3	C) Write a python program to find largest number among three numbers.
	4	D) Write a python Program to read a number and display corresponding day using if_elif_else?

3	1	A) Write a program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments.
	2	B) Write a python program to check whether the given string is palindrome or not.
	3	C) Write a python program to find factorial of a given number using functions
	4	D) Write a Python function that takes two lists and returns True if they are equal otherwise false
4	1	A) Write a program to double a given number and add two numbers using lambda()?
	2	B) Write a program for filter() to filter only even numbers from a given list.
	3	C) Write a program for map() function to double all the items in the list?
	4	D) Write a program to find sum of the numbers for the elements of the list by using reduce()?
5	1	A) Demonstrate a python code to implement abnormal termination?
	2	B) Demonstrate a python code to print try, except and finally block statements
	3	C) Write a python program to open and write "hello world" into a file?
	4	D) Write a python program to write the content "hi python programming" for the existing file.
6	1	A) Write a python program to get python version.
	2	B) Write a python program to open a file and check what are the access permissions acquired by that file using os module?
	3	C) Write a python program to display a particular month of a year using calendar module.
	4	D) Write a python program to print all the months of given year.

7	1	A) Write a python program to print date, time for today and now.
	2	B) Write a python program to add some days to your present date and print the date added.
	3	C) Write a python program to print date, time using date and time functions
	4	D) Write a python program which accepts the radius of a circle from user and computes the area (use math module).
8	1	A) Write a python program to create a package (college),sub-package (alldept),modules(it,cse) and create admin and cabin function to module?
	2	B) Write a python program to create a package (Engg), sub-package(years),modules (sem) and create staff and student function to module?
9	1	A) Write a python Program to display welcome to MRCET by using classes and objects.
	2	B) Write a python Program to call data member and function using classes and objects
	3	C) Write a program to find sum of two numbers using class and methods

22MC401	Machine Learning (3-0-0)	3 Credits

Course Objective:

1. Develop a concise knowledge on understanding of the fundamental concept of machine learning.
2. Understand the different learning algorithms and implement them.
3. Gain experience in applying machine learning algorithms to real world problem.

Module-I: [6 Hrs.]

Introduction to Machine Learning, Model Preparation, Modeling and Evaluation, Human learning versus machine learning, types of machine learning, applications of machine learning, tools for machine learning, Machine Learning Activities, Data structures for machine learning, Data Pre-processing, selecting a model, training a model, model representation and interpretability, evaluating performance of a model, improving performance of a model, Learning theory, Hypothesis and target class, Hilbert space, Inductive bias and bias-variance tradeoff.

Module-II: [6 Hrs.]

Feature Engineering, Bayesian Concept Learning, Introduction to feature engineering, feature transformation, feature subset selection, Importance of Bayesian methods, Bayes' theorem, concept learning through Bayes' theorem, Bayesian Belief Network

Module-III: [12 Hrs.]

Supervised Learning –Classification, Regression, Example of supervised learning, classification model, classification learning steps, common classification algorithms – KNN, Decision trees random forest, SVM, example of regression, common regression algorithms,

Module-IV: [12 Hrs.]

UnsupervisedLearning –Clustering, pattern finding using association rules, Unsupervised learning versus supervised learning, applications of unsupervised learning, clustering and its types, Apriori algorithm for association rule learning

Module-V: [4 Hrs.]

Neural Network: Understanding the biological neuron, exploring artificial neuron, types of activation functions, early implementation of artificial neural network, architectures of neural network, learning process in artificial neural network, back propagation, Overview of Deep Learning

Course Outcome:

1. Equip students with knowledge of fundamentals concepts in machine learning.
2. Ability to analyse and validate different learning algorithms.
3. fine tune machine learning algorithms and evaluate models generated from data.

Textbooks:

1: Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson Education

2: C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010.

Reference Books:

1. J. Friedman, T. Hastie, and R. Tibshirani.The elements of statistical learning.Vol. 1, no. 10. New York: Springer series in statistics, 2001.

2. S. Shalev-Shwartz, and S. Ben-David. Understanding machine learning: From theory to algorithms. Cambridge university press, 2014.

Digital Learning Resources

Course Name	Introduction to Machine Learning
Course Link	https://nptel.ac.in/courses/106/106/106106139/

22MC402	Internet & Web Technology (3-0-0)	3 Credits

Course Objective:

1. Develop dynamic web pages using HTML, CSS and Java Script.
2. Develop applications using JDBC.
3. Develop a small web site using Servlets and ,JSP and database.
4. Understanding the requirement of various frameworks Spring and Hibernate.

Module 1 **(8 Hours)**

Introduction to Web Application: - Introduction and overview of networking concept and Client Server Architectural Model, 3 Tier Architecture, Internet and World Wide Web, Web Browsers, Web Servers, URLs, HTTP, Web applications.

Web Programming: - Basics of HTML Programming: HTML Tags, images, hyperlinks Tables, List, Forms, Frames, CSS, Basic JavaScript Programming: DOM, Loops, function, arrays, form validation, Event handling, XML: Document structure, DTD, XML Schema and Parsing XML documents.

Module II **(8 Hours)**

Basics of JDBC: Architecture of JDBC, Various types of JDBC drivers, Programming with JDBC**,** creating a database using MySQL, Loading the Driver, Establishing the Connection, Creating Statements (Statement/Prepared Statement/Callable Statement), Executing a SQL Query, manipulating various SQL Queries, Result, Set, Creating Database Connectivity Applications

Module III **(10 Hours)**

Enterprise Java Programming: Java Servlet Technology: Introduction to Servlet, Web Servers and its Containers, Lifecycle of a Servelet, Servelet API, Servlet Packages, Types of servlets, Servlet Config, Servlet Context, sendRedirect(), Request Dispatcher forward(), Session tracking in Servlet, Cookies ,Servlet Filters, Servlet code for mailing using Mail API.

Database Programming: Servlet to DBMS communication using type-4 connection, Servlet communication with other servlets (Servlet Chaining), Servlet communication with JSP or HTML page, Database Access using Servlet.

Module IV **(8 Hours)**

JSP Technology: - Architecture & Anatomy of JSP Page, JSP life cycle, JSP with MVC Architecture, Dynamic webpage Creation, Significance of JSP Engine, Built in objects of JSP, Scripting Elements, Directive tags, Action tags ,Session Tracking, Database access using JSP page, JSTL, Concept of Ajax. Introduction to Java Server Faces (JSF) Technology.

Module V **(6 Hours)**

Enterprise JavaBeans Technology: EJB Component Architecture, Role of EJB & its life cycle, Types of Beans, Stateless and stateful beans, Overview on Spring: Spring Container, Bean Factory, Application Context , Aspects, Spring MVC, Hibernate.

Course Outcome:

1. Design and implementation of Web pages using HTML, Java Script and CSS.
2. Develop JDBC applications.
3. Implement server-side script using Servest's.
4. Develop dynamic web pages using JSP, develop a web site using JSP, Servlet and Database. Analyze the benefits of various frameworks like Spring, Hibernate.

Suggested Books and Reading Materials:

1. Java Server Programming Java EE6 (J2EE 1.6) Black Book, Kogent Solution Inc.
2. Head First Servlets and JSP 3rd Edition by Bert Bates (Author), Kathy Sierra (Author), Bryan Basham
3. Web Enabled Commercial Application Using HTML, DHTML, JAVA SCRIPT, PERL, CGI ,Ivan Bayross BPB Publication.

Course Name	JDBC Servlets and JSP - Java Web Development Fundamentals
Course Link	https://www.udemy.com/jdbcservletsandjsp/
Course Instructor	Create Java Web Applications from scratch in easy steps by Bharath Thippi Reddy

ELECTIVE-II

22MC403	Internet of Things (IoT) (3-0-0)	3 Credits

Course Objective

1. To learn the basic issues, policy and challenges in the Internet.
2. To get an idea of the application areas where Internet of Things can be applied.
3. To understand the cloud and internet environment and various modes of communications with Internet.
4. To understand the various modes of communications with Internet.

Syllabus

Module1: [10 Hrs]

Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels. Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style, Challenges and Issues.

Module 2: [10 Hrs]

M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG

Module-3: [10 Hrs]

IoT Protocols: Protocol Standardization for IoT and WSN Protocols-SCADA and RFID Protocols-Issues with IoT Standardization Protocols IEEE802.15.4-BACNet Protocol- , Architecture - Network layer – APS Layer – Security.

Module-4: [10 Hrs]

Data Analytics for IoT; Introduction Appache Hadoop, using HadoopMapReduce for Batch Data Analysis, Ethics: Characterizing the IoT,Privacy, Control, Distributing Control and Crowd Sourcing, Environment, Physical Thing, Electronics, InternetService, Solutions, Internet of Things as Part of Solution, Cautious Optimizing, The Open IoT definition.

Course Outcome:

1. Understand the definition and significance of the Internet of Things
2. Discuss the architecture, operation, and business benefits of an IoT solution
3. Examine the potential business opportunities that IoT can uncover
4. Explore the relationship between IoT, cloud computing, and big data

Text Book:

1. VijayMadisetti, Arshdeep Bahga," Internet of ThingsA Hands-On- Approach",2014, ISBN:978 0996025515

2. Honbo Zhou, "The Internet of Things in the Cloud:A Middleware Perspective" — CRC Press-2012.

3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.

Suggested Book:

1. Atzori, L., Iera, A., & Morabito, G. (2010). The internet of things: A survey. *Computer networks*, *54*(15), 2787-2805.
2. Hersent, O., Boswarthick, D., & Elloumi, O. (2011). *The internet of things: Key applications and protocols*. John Wiley & Sons.
3. Tan, L., & Wang, N. (2010, August). Future internet: The internet of things. In *2010 3rd international conference on advanced computer theory and engineering (ICACTE)* (Vol. 5, pp. V5-376). IEEE.
4. Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). (2011). *Architecting the internet of things*. Springer Science & Business Media.

Course Name	INTRODUCTION TO INTERNET OF THINGS
Course Link	https://nptel.ac.in/courses/106/105/106105166/
Course Instructor	PROF. SUDIP MISRA Department of Computer Science and Engineering, IIT Kharagpur

22MC404	Computer Network Security (3-0-0)	3 Credits

Course Objective:

1. To understand basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To understand various protocols for network security to protect against the threats in the networks

UNIT-1

Introduction to Security: What is security? Why we need Security? Security concerns, Security Goals: Confidentiality, Integrity, Availability, Authenticity and Accountability, Computer security challenges, Security Breach Impact levels: Low, Moderate and High, Security threats/attacks: passive and active, Security Policy, Security issues, Brief History of Malware, Types of Malware, Network Security Audit, The Orange Book, Legal Issues.

TCP/IP Security Attacks: TCP Segment Format, TCP Connection Setup, TCP Disconnection, IP Address Spoofing, Covert Channel, IP Fragment Attacks, TCP Flags, Syn Flood, Ping of Death, Smurf, Fin, UDP Flood Attack, Connection Hijacking, ARP Spoofing, DNS Spoofing, E-Mail Spoofing, Web Spoofing.

UNIT-2

Introduction to Cryptography, Symmetric-Key Cryptography: Traditional Ciphers, Simple Modern Ciphers, Modern Round Ciphers, Mode of Operations. Asymmetric-key Cryptography: RSA and Diffie-Hellman.

Network Security: Security Services, Message Confidentiality, Message Integrity, Message Authentication: MAC and HMAC, Digital Signature, Key Management: Symmetric-key Distribution: KDC, Session Keys, Kerberos, Public-key Distribution: Certification Authority, X.509, PKI.

UNIT-3

Authentication, Authentication methods, Passwords, Challenge-Response, Biometrics, Something you have, Two-factor authentication., Single Sign-On and Web Cookies. Authorization, A brief history of authorization, Access control matrix, Compartments, Covert Channel, Inference Control, CAPTCHA, Firewalls and Proxies, Defense in depth, Computer Networks security zones, Concept of Demilitarized Zones (DMZ) in designing Corporate Networks, Analysis of Network Infrastructure, DMZ: Mail server, WWW Server, DNS Server. Network flooding, Anticipating attacks, IDS.

UNIT-4

Simple Security Protocols, Authentication Protocols: authentication using symmetric keys, authentication using public keys, session keys, perfect forward secrecy, mutual authentication, session keys, and PFS, Timestamps, Authentication and TCP, Zero knowledge proofs. SSH, SSL/TSL: SSL and Man-in-the-Middle, SSL connections, SSL Versus IPSec, , IPSec: IKE Phase I: Digital Signature, Symmetric Key, Public Key Encryption, IPSec Cookies, IKE. Phase II, IPSec and IP Datagrams, Transport and Tunnel Modes, ESP and AH, Application Layer Security: Pretty Good Privacy (PGP).

UNIT-5

Introduction to Blockchain & Distributed Ledger technology (DLT): Bitcoin, Blockchain Architecture, Key Characteristics of Blockchain, Taxonomy of Blockchain systems,

Course Outcome:

The learners would be able to

1.Provide security of the data over the network.

2.Do research in the emerging areas of cryptography and network security.

3.Implement various networking protocols.

4.Protect any network from the threats in the world.

Text Books:

1. William Stallings, “Crpyptography and Network security Principles and Practices”,Pearson/PHI.

2. Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with codingtheory”, Pearson.

Reference Books:

1. W. Mao, “Modern Cryptography –Theory and Practice”, Pearson Education.

Charles P. Pfleeger, Shari Lawrence Pfleeger –Security in computing –Prentice Hall of India.

22MC405	Web application Development (3-0-0)	3 Credits

Course Objectives:

1. Define the basics in web design
2. Visualize the basic concept of HTML.
3. Recognize the elements of HTML.
4. Introduce basics concept of CSS.
5. Develop the concept of web publish

Unit-1

Web Design Principles

1.1 Basic principles involved in developing a web site, 1.2 Planning process, 1.3 Five Golden rules of web designing, 1.4 Designing navigation bar, 1.5 Page design, 1.6 Home Page Layout

1.7 Design Concept.,

2.0 Basics in Web Design, 2.1 Brief History of Internet, 2.2 What is World Wide Web, 2.3 Why create a web site, 2.4 Web Standards, 2.5 Audience requirement.

Unit-2

3.0 Introduction to HTML,

3.1 What is HTML, 3.2 HTML Documents, 3.3 Basic structure of an HTML document, 3.4 Creating an HTML document, 3.5 Mark up Tags, 3.6 Heading-Paragraphs, 3.7 Line Breaks, 3.8 HTML Tags

4.0 Elements of HTML

4.1 Introduction to elements of HTML, 4.2 Working with Text, 4.3 Working with Lists, Tables and Frames, 4.4 Working with Hyperlinks, Images and Multimedia, 4.5 Working with Forms and controls.

Unit-3

5.0 Introduction to Cascading Style Sheets

5.1 Concept of CSS, 5.2 Creating Style Sheet, 5.3 CSS Properties, 5.4 CSS Styling(Background, Text Format, Controlling Fonts), 5.5 Working with block elements and objects, 5.6 Working with Lists and Tables, 5.7 CSS Id and Class,5.8 Box Model(Introduction, Border properties, Padding

Properties, Margin properties), 5.9 CSS Advanced(Grouping, Dimension, Display,Positioning, Floating, Align,Pseudo class, Navigation Bar, Image Sprites, Attribute sector), 5.10 CSS Color

5.11 Creating page Layout and Site Designs

Unit-4

6.0 Introduction to Web Publishing or Hosting

6.1 Creating the Web Site, 6.2 Saving the site, 6.3 Working on the web site, 6.4 Creating web site structure, 6.5 Creating Titles for web pages, 6.6 Themes-Publishing web sites.

22MC407	Cloud Computing (3-0-0)	3 Credits

Course Objective:

To understand the concepts of Cloud Computing.
To learn Taxonomy of Virtualization Techniques.
To learn Cloud Computing Architecture.
To acquire knowledge on Aneka Cloud Application Platform.
To learn Industry Cloud Platforms.

Unit-1

Introduction to Cloud: Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. Virtualization: Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-

Before the Move into the Cloud: Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications..

Unit-2

Cloud Computing Architecture : Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance. Ready for the Cloud: Web Application Design, Machine Image Design, Privacy Design, Database Management, Data Security, Network Security, Host Security, Compromise Response.

Unit – 3

Defining the Clouds for Enterprise: Storage as a service, Database as a service, Process as a service, Information as a service, Integration as a service and Testing as a service. Scaling a cloud infrastructure - Capacity Planning, Cloud Scale. Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management

Unit-4

Aneka: Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, FabricServices, FoundationServices, ApplicationServices, Building Aneka Clouds, InfrastructureOrganization, LogicalOrganization, Private Cloud Deployment Mode, Public Cloud Deployment Mode,Hybrid Cloud Deployment Mode, Cloud Programming and Management,Aneka SDK, Management Tools.

Unit-5

Cloud Applications: Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming. Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and

Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.

Textbook:

Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi from TMH 2013.

George Reese Cloud Application Architectures, First Edition, O"Reilly Media 2009. Reference Book:

3:Cloud Computing and SOA Convergence in Your Enterprise A Step-by-Step Guide by David S. Linthicum from Pearson 2010.

Cloud Computing 2 nd Edition by Dr. Kumar Saurabh from Wiley India 2012.

5 Cloud Computing – web based Applications that change the way you work and collaborate Online – Micheal Miller.Pearson Education.

22MC411	Data Science (3-0-0)	3 Credits

Course Objectives :

1. Introduce R as a programming language
2. Introduce the mathematical foundations required for datascience
3. Introduce the first level data science algorithms
4. Introduce a data analytics problem solving framework
5. Introduce a practical capstone case study

MODULE -I
[8 Hrs]

Introduction: Introduction to Data Science, Data Science Venn Diagram, Relation to data mining, machine learning, big data and statistics, Business Intelligence (BI) vs. Data Science. Types of Data: Structured v/s unstructured data, Examples of data pre-processing, Quantitative vs qualitative data, Four levels of data. Stages of a data science project: Defining the goal, Data collection and management, Explore the data, Modeling, Model evaluation and critique, Presentation and documentation.

MODULE -II
[8 Hrs]

Introduction to Linear algebra for data science: Vectors and matrices.
Introduction to Probability: Bayesian versus Frequentist, Frequentist approach, The law of large numbers, Compound events, Conditional probability, Bayesian ideas revisited, Bayes theorem , More applications of Bayes theorem, Random variables, Discrete random variables.
Basic Statistics: Obtaining data (Observational, Experimental), Sampling data, Probability sampling, Random sampling, Unequal probability sampling, measurement of statistics , Measures of center (Mean, Median, Mode, Skewness, Quantile, Percentile), Measures of variation, Measures of relative standing, Correlations in data, The Empirical rule.

MODULE -III
[12 Hrs]

Data Visualization: Basic principles, ideas and tools for data visualization, Identify effective and ineffective visualization (Scatter plots, Line graphs, Bar charts, Histograms, Box plots), Correlation versus causation, Simpson's paradox, Verbal communication.
Machine Learning Essentials: Machine learning, Working principles, Types of machine learning (Supervised learning, Unsupervised learning, Reinforcement learning), How does statistical modeling fit. Some Basic Algorithms like Linear Regression, k-Nearest Neighbors (k-NN), k-Means, Decision Tree. Feature Extraction, Eigen vectors and Eigen values, Principal Component Analysis (PCA).

MODULE -IV **[6 Hrs]**
Beyond the Essentials: The bias variance tradeoff (Error due to bias, Error due to variance, Two extreme cases of bias/variance tradeoff, How bias/variance play into error functions), K folds cross-validation, Grid searching (Visualizing training error versus cross-validation error), Ensembling techniques (Random forests, Comparing Random forests with decision trees), Introduction to structure of Neural networks.

MODULE -V
[6 Hrs]
Hands on laboratory using R Language for example like Data Visualization (Scatter plots, Line graphs, Bar charts, Histograms, Box plots), Some Basic Algorithms like Linear Regression, k-Nearest

Neighbors (k-NN), k-Means, Decision Tree. Principal Component Analysis (PCA), Random Forests, Neural Networks.

Course Outcomes:

1. Describe a flow process for data science problems (Remembering)
2. Classify data science problems into standard typology (Comprehension)
3. Develop R codes for data science solutions (Application)
4. Correlate results to the solution approach followed (Analysis)
5. Assess the solution approach (Evaluation)
6. Construct use cases to validate approach and identify modifications required

Text Books:

2. Principles of Data Science, Sinan Ozdemir, Packt Publishing Ltd 2016.
3. Doing Data Science, Straight Talk From The Frontline, Cathy O'Neil and Rachel Schutt., O'Reilly. 2014.
4. An Introduction to Statistical Learning with Applications in R. James G, Witten D, Hastie Tibshirani R, Springer, 2013.
5. Hands-On Data Science with R: Techniques to perform data manipulation and ...,Vitor Bianchi Lanzetta, Nataraj Dasgupta, Ricardo Anjoleto Farias, Packt publishing ltd, 2018.
6. Data Science for Engineers : https://swayam.gov.in/nd1_noc19_cs60/preview (Prof. Raghunathan Rengasamy & Prof. Shankar Narasimhan, IIT Madras).
7. https://www.udemy.com/course/data-science-and-machine-learning-bootcamp-with-r/ (Created by Jose Portilla)
8. https://www.udemy.com/machinelearning/ Machine Learning A-Z™: Hands-On Python & R In Data Science By: Kirill Eremenko, Hadelin de Ponteves

22MC412	Software testing and Quality Assurance	3 Credits

Course Objective:

Introduce basic concepts of software testing

Understand white box, block box, object oriented, web based and cloud testing

Know in details automation testing and tools used for automation testing

Understand the importance of software quality and assurance software systems development.

Module-I

Quality Revolution, Software Quality, Role of Testing, Verification and Validation, Failure, Error, Fault and Defect, Notion of Software Reliability, Objective of Testing, What is a Test Case?, Expected Outcome, Concept of Complete Testing, Testing Activities, Test Oracle, Testing Levels, Regression Testing, White-Box and Black Testing, Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation

Unit Testing: Concept of Unit Testing, Static and Dynamic unit Testing, Mutation Testing, Debugging, Unit Testing in eXtreme Programming.

Module-II

Control Flow Testing: Outline of Control Flow Testing, Control Flow Graph, Path in a CFG, Path selection Criteria, All-Path Coverage Criterion, Statement Coverage Criterion, Branch Coverage Criterion, Generation of Test Input, Example of Test Data Selection.

Data Flow Testing:Data Flow Anomaly, Overview of Dynamic Data Flow Testing, Data Flow Graph, Data Flow Terms, Data Flow Testing Criteria, Comparison of Data Flow Test Selection Criteria, Feasible Paths and Test Selection Criteria, Comparison of Testing Techniques.

System Integration Testing:Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Software and Hardware Integration, Test Plan for System Integration, Off-the-Shelf Component Integration, Off-the-Shelf Component Testing, Built-in Testing

Module-III

System Test Categories:Basic Tests, Functionality Tests, Robustness Tests, Interoperability Tests, Performance Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Documentation Tests.

Functional Testing:Equivalence Class Partitioning, Boundary Value Analysis, Decision Tables, Random Testing, Error Guessing, Category Partition.

System Test Planning and Automation:Structure of a System Test Plan, Introduction and Feature Description, Assumptions, Test Approach, Test Suite Structure, Test Environment, Test Execution Strategy, Test Effort Estimation, Scheduling and Test Milestones, System Test Automation, Evaluation and Selection of Test Automation Tools, Test Selection Guidelines for Automation, Characteristics of Automated Test Cases, Structure of an Automated Test Case, Test Automation Infrastructure.

Acceptance Testing:Types of Acceptance Testing, Acceptance Criteria, Selection of Acceptance Criteria, Acceptance Test Plan, Acceptance Test Execution, Acceptance Test Report, Acceptance Testing in eXtreme Programming.

Module-IV

Software Reliability: Definition, Factors Influencing Software Reliability, Application of Software Reliability, Operational Profiles.

Software Quality:Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard ISO 9000:2000 Fundamentals, ISO 9001:2000 Requirements.

Maturity Models: Basic Idea in Software Process, Capability Model(CMM) Model, Architecture, Five Levels of Maturity and Key Process Areas, Common Features of Key Practices, Application of CMM, CMMI, Test Process Improvement (TPI), Testing Maturity Model (TMM).

Textbook:

1. Software Testing and Quality Assurance: Theory and Practice, Kshirasagar (Sagar) Naik, University of Waterloo, Priyadarshi (Piyu) Tripathy, NEC, Wiley , 2008.

Reference Book:

Software Quality Assurance, Daniel Galin, Pearson Education

22MC413	Blockchain Technology	3 Credits

Course Outcome:

1. Explain design principles of Bitcoin and Ethereum, Explain Nakamoto consensus, Explain the Simplified Payment Verification protocol.
2. List and describe differences between proof-of-work and proof-of-stake consensus.
3. Interact with a blockchain system by sending and reading transactions. Design, build, and deploy a distributed application.
4. Evaluate security, privacy, and efficiency of a given blockchain system

Course Objective:

1: Understand how blockchain systems (mainly Bitcoin and Ethereum) work,

2: To securely interact with them,

3: Design, build, and deploy smart contracts and distributed applications,

4: Integrate ideas from blockchain technology into their own projects

Module-1: [8 Hrs.]

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance,Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, ZeroKnowledge Proof.

Module-2: [12 Hrs.]

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain

Module-3: [10 Hrs.]

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate,

Module-4: [10 Hrs.]

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy.

Applications: Internet of Things, Medical Record Management System, Domain Name Service

Textbooks:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

22MC408	Machine Learning Laboratory (0-0-4)	2 Credits

Course Objective:

1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice.

Laboratory Experiments

1. Build a multivariate logistic regression model to classify glass type of glass given different glass mixture features using the Glass Identification Dataset from UCI Machine Learning Repository.
2. Implement supervised machine learning algorithm (Classification – K Nearest Neighbourhood) in python to classify breast tumour data into malignant breast tumour or benign breast tumour and obtain its accuracy level.
3. Implement supervised machine learning algorithm (Classification – K Nearest Neighbourhood) in python to classify iris data into setosa, virginica, versicolor using iris dataset and obtain its accuracy level.
4. Implement supervised machine learning algorithm (Classification – Naïve Bayes algorithm) in python on Pima Indians Diabetes dataset and obtain its accuracy level.
5. Implement supervised machine learning algorithm (Classification – Support Vector Machine) in python to classify breast tumour data into malignant breast tumour or benign breast tumour (use breast tumour dataset) and obtain its accuracy level.
6. Write a python program to build an email spam classifier using support vector machines for the Spam base dataset from UCI machine learning repository.
7. Implement unsupervised machine learning algorithm (Clustering – K Means) in python on Titanic/Iris dataset to cluster data by removing the class label.
8. Implement unsupervised machine learning algorithm (Clustering – K Means) in python on Breast Tumour dataset to cluster data by removing the class label.
9. Implement unsupervised machine learning algorithm (Clustering –Hierarchical) in python on Titanic dataset to cluster data (use Titanic dataset).
10. Implement text classification using neural network in python on Twenty Newsgroup dataset from UCI machine learning repository.

References:

1) Peter Harrington, “Machine Learning in Action”, DreamTech
2) Michael Bowles, “Machine Learning in Python”, Wiley
3) Gavin Hackeling, Mastering Machine Learning with scikit-learn, Packt
4) Giuseppe Bonaccorso, Machine Learning Algorithms - Second Edition, Packt

Course Outcome:

1. Understand the implementation procedures for the machine learning algorithms
2. Design Java/Python programs for various Learning algorithms.
3. Apply appropriate data sets to the Machine Learning algorithms
4. Identify and apply Machine Learning algorithms to solve real world problems

22MC409	Internet & Web Technology Laboratory (0-0-4)	2 Credits

Course Objective:

1. Develop dynamic web pages using HTML, CSS and Java Script.
2. Develop applications using JDBC.
3. Develop a small web site using Servlets and ,JSP and database.
4. Understanding the requirement of various frameworks Spring and Hibernate.

Laboratory Experiments

01. HTML & XHTML Programming: basic tags, text formatting tags, creating hyperlinks.
02. HTML & XHTML Programming: tables, lists, frames, forms, maps, Creating CSS.
03. JavaScript Programming: Data types, loops, functions.
04. JavaScript Programming: DOM, arrays, forms, frame, GUI design.
05. XML Programming: page creation, making a DTD, Parsing XML files.
06. Creating, installation and running a web server (e.g. Apache Tomcat/ GlassFish).
07. Creating, Compiling and Running a Servlet. Program (both http & generic servlet).
08. Implementing session tracking mechanisms in servlets.
09. Generating Dynamic web content using Servlet basing upon request response model.
10. DHTML programming: GUI designs.
11. Creating a JSF program showing framework-based application development.
12. Creating, Compiling and Running a JSP Program.
13. Implementing Session tracking through JSP Program.
14. Access to a database using Servlet/JSP program.
15. Creating a simple Java Bean Application programs using BDK. Tools.
16. Deploying of beans, implementing entity beans and session beans of EJB.
17. Creating manifest file, jar file and Deploying a web application.
18. Designing a simple Program using JDBC, beans and JSP implementing MVC Model.
19. Creating a RMI Program showing Marshalling and Unmarshalling Processes.
20. A Web based Capstone project university management system using JSP and Database.

Course Outcome:

1. Design and implementation of Web pages using HTML, Java Script and CSS.
2. Develop JDBC applications.
3. Implement server-side script using Servest's.
4. Develop dynamic web pages using JSP, develop a web site using JSP, Servlet and Database. Analyze the benefits of various frameworks like Spring, Hibernate.

1. .

22MC410	**Major Project/ Industrial Training (0-0-24)**	**12 Credits**