SYLLABUS

for

Bachelor of Computer Applications

Programme

As Per

New Education Policy (NEP-2020)

Hemvati Nandan Bahuguna Garhwal University

A Central University

Course Structure for Bachelor of Computer Application Programme as Per NEP 2020								
Semester	Major Subject (Core Subject) (6 Credits)	Additional/ Interdisciplinary subject/ Multidisciplinary (4 Credits)	Skill Course/ Vocational Course (2 Credits)	Vocational Course/ Field Visit/ Entrepreneurship skills (4 Credits)	Discipline specific/ Open Elective/Project	Extracurricular Courses/ Compulsory course (2 Credits)	*Extracurricular Courses/CC (2 Credits)	Total Credits
I	Computer Fundamental (4) + Computer Fundamental Lab (2) Programming in 'C' (4) + Programming in 'C' Lab (2)	Internet Technologies (3) + HTML Lab (1)	Mathematical Foundation/ Office Automation/ PC hardware (2)	Not Applicable	Not Applicable		*Life Skills and Personality development (2)	20
II	Programming in C++ (4) + Programming in C++ Lab (2) Computer Architecture and Digital Electronics (4) + Computer Architecture and Digital Electronics LAB (2)	Computer Based Numerical Techniques (3) + Computer Based Numerical Techniques Lab (1)	Linux Environment / Cyber Security / Business Intelligence (2)	Not Applicable	Not Applicable		*Understanding and connecting with Environment (2)	20
Exit option with Certificate in Computer Application (40 Credits)								
III	Data Structure & File Organization (4) + Data Structure & File Organization lab (2) Operating System (4) + Operating System Lab (2)	Python Programming (3) + Python Programming lab (1)	Modelling & Simulation/ Graph Theory/ Informatics Cyber laws (2)				*Indian Knowledge System-I (2)	20
IV	Computer Networks (4) + Computer Networks lab (2) Database Management System (4) + Database Management System Lab (2)	R Programming (3) + R Programming lab (1)	System Administrator/ Software Testing/ Software Engineering (2)				*Indian Knowledge System-II (2)	20

Exit option with Diploma in Computer Application (80 Credits)								
V	Compiler Design (4) + Compiler Design lab (2) Computer Graphics (4) + Computer Graphics Lab (2)			Multimedia Application (2)	ASP.Net/ Pattern Recognition/ SQL/PL-SQL (4) + DSE 1 Lab (2)			20
VI	Cryptography & Network Security (4) + Cryptography & Network Security lab (2) Design and Analysis of Algorithm (4) + Design and Analysis of Algorithm Lab (2)			E-Commerce (2)	Image Processing/ Parallel Programming/ Data Compression (4) + Project (2)			20
Exit option with Degree in Bachelor of Computer Application (120 Credits)								
VII	Artificial Intelligence (4) + Artificial Intelligence lab (2) Cloud Computing (4) + Cloud Computing Lab (2)			Fundamental of Data Science (2)	Internet of Things/ Machine Learning/ Data Analytics (4) + DSE 2 Lab (2)			20
VIII	Deep Learning (4) + Deep learning lab (2) Wireless and Mobile Computing (4) + Wireless and Mobile Computing Lab (2)			Blockchain Technology (2)	Thesis/Dissertation (06)			20
Exit option with Degree in Bachelor of Computer Application with Research (160 Credits)								

PROGRAMME OUTCOMES (POs)

Upon completion of the BCA program:

PO1. Students gain a solid understanding of fundamental computer science concepts, including programming languages (such as C, C++, and Java), data structures, algorithms, computer organization, and operating systems.

PO2. BCA graduates develop proficiency in programming and software development. They learn to write, debug, and maintain code for various applications and scenarios.

PO3. Students learn about database concepts, database design, and management. This includes understanding SQL (Structured Query Language) for querying and manipulating databases.

PO4. BCA programs often cover web technologies, including HTML, CSS, JavaScript, and web development frameworks. Graduates can create dynamic and interactive web applications.

PO5. Students are exposed to software engineering principles such as software development life cycles, requirements analysis, software testing, and project management.

PO6. BCA graduates develop strong problem-solving and critical-thinking skills, which are essential for identifying and solving technical challenges.

PO7. Students learn about ethical considerations in the field of computing, including issues related to privacy, security, and intellectual property.

PO8. Many BCA programs include group projects that foster teamwork and collaboration, preparing students for real-world work environments.

PO9. Students are prepared for various entry-level roles in the IT industry, such as software developer, web developer, database administrator, system analyst, and more.

PO10. Effective communication is emphasized throughout the program. Graduates are equipped to explain complex technical concepts to both technical and non-technical audiences.

PO11. BCA can serve as a stepping stone for further education, such as pursuing a master's degree in computer science or related fields, to specialize in a specific area of interest.

FIRST SEMESTER

Course: Computer Fundamental

Course Objective: This course aims to provide a comprehensive understanding of computer hardware components and functions, covering disk storage, memory, input/output devices, and peripherals. It introduces basic operating system concepts including MS-DOS and Windows, along with networking fundamentals such as internet basics, TCP/IP, and client-server architecture. Students will grasp number systems, logic operations, and programming fundamentals, while also gaining insights into language generation, assembly languages, and high-level languages.

Course Outcome: On successful completion of the course, students will be able to:

1. Understand the concept of hardware and software.
2. Acquainting with input and output devices.
3. Understand networking concepts and models.
4. Learn and aware of Internet activities.

Course Content:

Unit 1 Computer Hardware Components and Functions

Introduction to Computers: Computer hardware Components, Disk Storage, memory, keyboard, mouse, printers, monitors, CD etc., and their functions, Comparison Based analysis of various hardware components.

Unit 2 Basic Operating System Concepts and Networking

Basic Operating System Concepts: MS-DOS, WINDOWS, Functional knowledge of these operating systems. Introduction to Basic Commands of DOS, Managing File and Directories in various operating Systems, Introduction to internet, Basic terms related with Internet, TCP/IP. Network Topologies, Client-server Architecture, IoT, Cloud Computing

Unit 3 Number Systems, Logic Operations, and Programming Fundamentals

Binary, Hexadecimal Number System; Basic Binary Logic Operations; Binary Addition and Subtraction; Generation of Languages, Assembly Language, High level language; Translators, Interpreters, Compilers, Algorithm, Flow Charts, Dataflow Diagram,

Unit 4 Elements of a Computer Processing System and Software

Element of a computer processing system: Hardware CPU, storage devices and media, VDU, input-output devices, data communication equipment software-system software, application software.

Unit 5 NICNET, ERNET, E-commerce, and Multimedia Introduction

Basic Awareness of NICNET and ERNET; E Commerce, E governance; Brief Introduction to Different Formats of Image, Audio, Video. Data Concepts and Data Processing, Data Science, Data Representation, Application of IT to E-commerce, Electronic Governance, Multimedia, Entertainment, Introduction to Information System

Recommended Books:

1. Sinha, Sinha, “Computer Fundamentals”
2. Yadav R. P. , “Information Technology”

Course: Programming in C

Course Objective: The Programming in C course aims to provide students with a solid foundation in programming using the C language. Participants will start by learning the basics of C syntax, data types, and control structures, progressing to more advanced topics like functions, pointers, and memory management. The course focuses on developing problem-solving skills through hands-on coding exercises and projects, enhancing participants' ability to translate real-world problems into C programs.

Course Outcome: By the end of this course, students should be able to:

1. Understand the basic programming concepts and syntax of the C language.
2. Design and implement algorithms to solve simple programming problems.
3. Write, compile, and execute C programs using integrated development environments (IDEs).

Course Content:

Unit 1 Introduction to C Programming

Basics of C programming language, Structure of C program, Data types, Variables, Constants, Input and Output functions, Operators, Expressions, Control structures: if, if-else, switch.

Unit 2 Loops and Functions

Looping constructs: while, do-while, for, Nested loops, Arrays, Strings, Pointers, Functions: declaration, definition, call, return, and recursion.

Unit 3 Storage Classes and Preprocessor

Storage Classes: auto, extern, static, register, Scope and lifetime of variables, Introduction to the Preprocessor, Macros, Conditional compilation.

Unit 4 User-defined Data Types

Structures and Unions, Introduction to user-defined data types, Structures: declaration, initialization, accessing members, Arrays of structures, Pointers to structures, Unions: declaration, accessing members.

Unit 5 File Handling and Command-line Arguments

File operations: Opening, Reading, Writing, and Closing files, Random Access to files, Command-line arguments, File handling functions, Error handling.

Recommended Books:

1. "C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller.
2. "The C Programming Language" by Brian W. Kernighan

Course: Internet Technologies

Course Objective: The Internet Technologies course aims to provide participants with a comprehensive understanding of the foundational concepts and technologies that underpin the modern internet. Participants will explore the layers of the internet stack, from networking protocols and web technologies to security and emerging trends. The course covers web development essentials including HTML, CSS, and JavaScript, enabling participants to create interactive and responsive web pages. Participants will gain insights into server-side scripting languages, database integration, and server deployment.

Course Outcome: By the end of this course, students should be able to:

1. Understand the working principles of the internet and its protocols.
2. Develop static web pages using HTML and CSS.
3. Implement interactive features on web pages using JavaScript.

Course Content:

Unit 1 Introduction to Internet Technologies

Overview of the Internet and its evolution, Internet protocols: TCP/IP, HTTP, DNS, SMTP, etc., IP addressing and subnetting, Domain Name System (DNS), Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS).

Unit 2 Client-Side Web Technologies

JavaScript programming fundamentals, Document Object Model (DOM) manipulation, Client-side form validation, Introduction to Web development frameworks (e.g., React, Angular).

Unit 3 Server-Side Web Technologies

Server-side scripting languages (e.g., PHP, Python, Node.js), Handling HTTP requests and responses, Database connectivity and management, Session and cookies management.

Unit 4 Web Security and Emerging Technologies

Web security fundamentals: Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), etc., Secure Socket Layer (SSL) and Transport Layer Security (TLS), Introduction to Web services and APIs, Emerging technologies and trends in Internet Technologies.

Recommended Books:

1. "HTML and CSS: Design and Build Websites" by Jon Duckett.
2. "JavaScript and JQuery: Interactive Front-End Web Development" by Jon Duckett.

Course: Mathematical Foundation

Course Objective: The objective of the "Mathematical Foundations of Computer Science" course is to introduce students to the mathematical concepts and techniques that underpin various areas of computer science. The course aims to help students develop a strong foundation in mathematical reasoning and problem-solving skills that are essential for understanding algorithms, data structures, and theoretical aspects of computer science.

Course Outcome: By the end of this course, students should be able to:

1. Understand fundamental mathematical concepts and their applications in computer science.
2. Analyze algorithms and data structures using mathematical techniques.
3. Formulate and solve problems in computer science using mathematical modeling.
4. Apply mathematical reasoning to analyze the efficiency and correctness of algorithms.
5. Gain a deeper appreciation of the theoretical underpinnings of computer science.

Course Content:

Unit 1 Mathematical Logic

Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers

Unit 2 Set Theory

Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams

Unit 3 Functions

Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties, Algebraic Structures: Algebraic Systems, Properties, Semi Groups and Monoids, Group, Subgroup and Abelian Group, Homomorphism, Isomorphism.

Unit 4 Combinatorics

Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems

Unit 5 Number Theory

Properties of Integers, Division Theorem, Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's and Euler's Theorems

Recommended Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rd Edition, Tata McGraw Hill.

Course: Office Automation

Course Objective: The objective of an Office Automation course is to provide students with the necessary skills and knowledge to effectively use various computer software applications and technologies for streamlining and enhancing office tasks and processes. The course aims to equip students with practical abilities to automate routine office functions, improve efficiency, and facilitate communication and collaboration within an office environment.

Course Outcome: By the end of this course, students should be able to:

1. Effectively use office automation tools for document creation, presentation, and data analysis.
2. Apply advanced features of office software to optimize office tasks and workflows.
3. Demonstrate effective communication and collaboration skills using office automation tools.

Course Content:

Unit 1 Introduction to Office Automation

Overview of office automation and its benefits, Office Suite applications and their features. Ethical and Legal Considerations in Office Automation

Unit 2 Word Processing and Spreadsheets

Word processing: Formatting, Styles, Mail Merge, Spreadsheets: Formulas, Functions, Charts. Styles, Templates, and Document Automation, Collaboration Tools: Track Changes and Comments

Unit 3 Presentation Tools and Email Management

Creating and delivering presentations, Email and Calendaring: Managing emails and appointments.

Unit 4 Database Management and Workflow Automation

Database management: Creating and querying databases, Document collaboration and version control, Workflow automation using macros and scripts.

Unit 5 Streamlining Workflows and Future Trends

Making Tasks Easier: Workflow Automation, Looking Ahead: Modern Trends in Office Automation, Adapting to New Technologies, Enhancing Efficiency in the Digital Age

Recommended Books:

1. "Microsoft Office 365 & Office 2019: Introductory" by Misty E. Vermaat.
2. "Office 2019 All-in-One for Dummies" by Peter Weverka.

Course: PC Hardware

Course Objective: The "PC Hardware" course aims to provide participants with a comprehensive understanding of computer hardware components and their functionality. By the course's conclusion, students will be able to assemble, troubleshoot, and maintain personal computer systems. The objective is to equip students with practical skills for hardware configuration, upgrades, and diagnostics in various computing environments**.**

Course Outcome: By the end of this course, students should be able to:

1. Understand the components and functionality of PC hardware.
2. Assemble, disassemble, and configure computer systems.
3. Identify and troubleshoot hardware-related issues.

Course Content:

Unit 1 Introduction to PC Hardware components

Overview of PC hardware architecture, Motherboard and BIOS setup, Central Processing Unit (CPU) and Memory.

Unit 2 Storage Devices and Input-Output Devices

Hard Drives: HDD, SSD, Hybrid Drives, Storage Interfaces: SATA, NVMe, SCSI, Disk Partitions and File Systems, Data Storage Technologies: RAID, NAS, Cloud, Data Backup and Recovery Strategies, Diagnosing and Repairing Storage Problems

Unit 3 Expansion Cards and Power Supply

Expansion cards: Graphics cards, Sound cards, etc., Network Interface Cards (NIC) and Connectivity, USB and Other Port Types: Thunderbolt, Firewire, etc., Power supply and cooling systems.

Unit 4 PC Assembly, Troubleshooting, and Maintenance

PC assembly and hardware installation, Troubleshooting common hardware issues, Hardware maintenance and upgrades. BIOS and UEFI: Configuration and Upgrading

Recommended Books:

1. "CompTIA A+ Certification All-in-One Exam Guide" by Mike Meyers.
2. "Upgrading and Repairing PCs" by Scott Mueller.

Course: Life Skills and Personality Development

Course Objective: The Life Skills and Personality Development Course aims to equip participants with essential skills and knowledge to enhance their personal growth, interpersonal relationships, and overall well-being. The course is designed to empower individuals to navigate various life situations effectively, develop a positive self-image, and foster the traits necessary for a successful and fulfilling life.

Course Outcome: By the end of this course, students should be able to:

1. Develop effective communication skills, including active listening and empathetic expression.
2. Enhance emotional intelligence to manage emotions, empathize with others, and navigate social situations.
3. Cultivate resilience and stress management techniques to cope with challenges and setbacks.
4. Master time management and goal-setting, enabling efficient task prioritization and achievement.

Course Content:

UNIT 1 Career and Professional Skills

Career and Professional Skills: Listening Skills, Reading Skills, Writing Skills, Effective Resume preparation, Interview Skills, Group Discussion Skills, Exploring Career Opportunities, Psychometric Analysis and Mock Interview Sessions

Team Skills: Cognitive and Non-Cognitive Skills, Presentation Skills, Trust and Collaboration, Listening as a Team Skill, Brainstorming, Social and Cultural Etiquettes

Digital Skills: Computer skills, Digital Literacy and Social Media, Digital Ethics and Cyber Security

UNIT 2 Attitude and Motivation

Attitude: Concept, Significance, Factors affecting attitudes, Positive attitude - Advantages, Negative attitude- Disadvantages, Ways to develop positive attitude, Difference between personalities having positive and negative attitude.

Motivation: Concept, Significance, Internal and external motives - Importance of self- motivation- Factors leading to de-motivation, Maslow's Need Hierarchy Theory of Motivation

UNIT 3 Stress-management and Development of Capabilities

Development of will power, imagination through yogic lifestyle, Development of thinking, emotion control and discipline of mind through Pranayama, Improvement of memory through meditation-Stress: meaning, causes, and effects of stress in life management, Stress: psycho-physical mechanism, management of stress through Yoga.

UNIT 4 Other Aspects of personality Development

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills -Leadership and qualities of a successful leader - Character-building -Team-work - Time management -Work ethics – Good manners and etiquette.

UNIT 5 Health and Hygiene

Health and Hygiene- Meaning and significance for Healthy Life, Exercise and Nutrition and Immunity. Obesity- Meaning, Types and its Hazards. - Physical Fitness and Health Related Physical Fitness- Concept, Components and Tests, Adventure Sports.

Recommended Books:

1. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.
2. Ghosh, Shantikumar. 2004. Universal Values. Kolkata: The Ramakrishna Mission Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.

SECOND SEMESTER

Course: Object Oriented Programming using C++

Course Objective: The objective of this course is to introduce students to the principles and concepts of object-oriented programming using the C++ programming language. The course aims to develop students' skills in designing and implementing object-oriented solutions to real-world problems.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts of object-oriented programming.
2. Design and implement C++ programs using classes, objects, and inheritance.
3. Apply polymorphism and templates to develop reusable code.
4. Utilize advanced features of C++ to develop efficient and modular programs.

Course Content:

Unit 1 Introduction to Object-Oriented Programming (OOP)

OOP concepts: Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Vs. Object-Oriented Programming, Principles of OOP and their benefits.

Unit 2 C++ Programming Basics

Program structure and basic syntax in C++, Namespaces, Identifiers, Variables, Constants, Enums, Operators and typecasting in C++.

Unit 3 Classes and Objects

Classes and Objects in C++, Access specifiers: Public, Private, Protected, Constructors and Destructors in classes.

Unit 4 Inheritance and Polymorphism

Concept of Inheritance and its types, Polymorphism and function overloading, Virtual functions and abstract classes.

Unit 5 Exception Handling and File I/O

Introduction to exception handling, try-catch blocks, Exception propagation, File input and output operations in C++.

Recommended Books:

1. "C++ Primer" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo.
2. "Effective C++: 55 Specific Ways to Improve Your Programs and Designs" by Scott Meyers.

Course: Computer Architecture and Digital Electronics

Course Objective: The objective of this course is to introduce students to the fundamental principles and concepts of computer organization, architecture, and digital electronics. The course aims to provide students with a solid understanding of how computers are designed and how digital circuits operate, enabling them to comprehend the interactions between hardware and software components.

Course Outcome: By the end of this course, students should be able to:

1. Understand the architecture and organization of a computer system, including the CPU, memory, and I/O devices.
2. Comprehend the basic principles of digital electronics, including logic gates, flip-flops, and combinational and sequential circuits.
3. Analyze and design digital circuits using Boolean algebra and logic gate representations.
4. Explain the functioning of various computer components, such as registers, ALU, control unit, and memory hierarchy.
5. Evaluate the performance of computer systems and understand the trade-offs involved in hardware design.

Course Content:

Unit 1 Introduction to Digital Electronics

Number systems and binary arithmetic, Boolean algebra and logic gates, Combinational logic circuits, Sequential logic circuits and flip-flops.

Unit 2 Combinational Logic Design

Multiplexers and demultiplexers, Encoders and decoders, Adders, subtractors, and ALU design.

Introduction to HDL (Hardware Description Language) for circuit design.

Unit 3 Sequential Logic Design

Latches and flip-flops, Counters and shift registers, Finite State Machines (FSMs) and their design.

Unit 4 Computer Organization and Architecture

Von Neumann architecture, CPU organization and instruction execution cycle, Memory hierarchy and caching, Input and output devices and interfaces, DMA.

Unit 5 Advanced Topics

Pipeline architecture and instruction pipelining, Introduction to parallel processing and multi-core systems, Introduction to RISC (Reduced Instruction Set Computer) and CISC (Complex Instruction Set Computer) architectures, Overview of emerging trends in computer architecture.

Recommended Books:

1. Mano, M. M., & Ciletti, M. D. (2017). Digital Design.
2. Patterson, D. A., & Hennessy, J. L. (2017). Computer Organization and Design: The Hardware/Software Interface.

Course: Computer Based Numerical Techniques

Course Objective: The objective of this course is to provide students with an understanding of numerical techniques and algorithms for solving mathematical problems encountered in computer-based applications. The course aims to develop students' skills in applying numerical methods to practical problems.

Course Outcome: By the end of this course, students should be able to:

1. Understand the principles and importance of numerical techniques.
2. Apply numerical methods for solving mathematical problems.
3. Implement algorithms for numerical differentiation and integration.
4. Use interpolation techniques for data analysis and approximation.
5. Solve ordinary differential equations numerically.

Course Content:

Unit 1 Introduction to Numerical Techniques

Overview of numerical methods and their applications, Errors in numerical computations and methods to reduce them.

Unit 2 Solving Equations

Bisection method, Newton-Raphson method, Secant method, Root-finding techniques and convergence criteria.

Unit 3 Interpolation and Approximation

Interpolation methods: Lagrange interpolation, Newton's divided difference, Curve fitting techniques: Least squares approximation.

Unit 4 Numerical Integration and Differentiation

Numerical integration methods: Trapezoidal rule, Simpson's rule, Numerical differentiation techniques.

Unit 5 Linear Algebraic Equations and Eigenvalue Problems

Solving systems of linear equations: Gaussian Elimination, LU Decomposition, Eigenvalues and Eigenvectors using numerical methods.

Recommended Books:

1. "Numerical Methods: Principles, Analysis, and Algorithms" by Roland W. Freund and Gene H. Golub.
2. "Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery.

Course: Linux Environment

Course Objective: This Linux Environment course aims to equip participants with essential skills for effectively working within a Linux operating system. The course covers fundamental concepts including navigating the command line, managing files and directories, and understanding permissions. Students will also learn to create and execute shell scripts, automating tasks and boosting productivity.

Course Outcome: By the end of this course, students should be able to:

1. Be familiar with fundamentals of Linux operating system.
2. To learn the concepts of files and file organization.
3. To learn the mechanisms involved in ownership of files and file attributes
4. To gain the knowledge on vi editor and regular expressions
5. To know the techniques of shell programming.

Course Content:

Unit 1: Introduction to Linux Environment

What is Linux and Open Source? Linux Distributions and Installation, Getting Familiar with the Linux Command Line, Basic File Operations in Linux, User and Group Management in Linux

Unit 2: File System and Navigation

Understanding the Linux File System Hierarchy, Navigating the File System using Commands, Working with Directories and Files, File Permissions and Ownership, Archiving and Compression Tools in Linux

Unit 3: Process Management and System Monitoring

Processes and Jobs in Linux, Managing Processes: ps, top, and kill, Background and Foreground Jobs, Monitoring System Performance, System Resource Utilization and Troubleshooting

Unit 4: Shell Scripting Basics

Introduction to Shell Scripting, Writing Your First Shell Script, Variables and Data Types in Shell Scripts, Conditional Statements: if and case, Looping Constructs: for and while

Unit 5: Text Editing with VI Editor

Introduction to VI Editor, VI Modes: Command Mode, Insert Mode, and Visual Mode, Basic Text Editing and Navigation in VI, Advanced Editing and Search Techniques, Saving, Quitting, and Using VI for Efficient Editing

Recommended Books:

1. "Numerical Methods: Principles, Analysis, and Algorithms" by Roland W. Freund and Gene H. Golub.
2. "Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery.

Course: Cyber Security

Course Objective: This course is geared towards generating and enhancing awareness about cyber security challenges and the concepts of cyber security and cyber ethics among the students to help them become responsible cyber citizens and participate safely and securely in the rapidly evolving information-age society

Course Outcome: By the end of this course, students should be able to:

1. Remember the broad set of technical, social & political aspects of Cyber Security.
2. Understand the importance of ethical hacking, its tool and ethical hacking process.
3. Analyse security principles to system design.
4. Understand the methods for authentication, access control, intrusion detection and prevention in Cyber Security

Course Content:

Unit 1 Fundamentals of Cyber Security and Threat Landscape

Importance and challenges in Cyber Security, Cyberspace, and Cyber threats, Cyber warfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure

Unit 2 Cyber Attacks and Intrusion Techniques

Types of Hackers - Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access - Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks. Worms, Trojans, Viruses, Backdoors

Unit 3 Ethical Hacking and Information Security Practices

Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modeling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing

Unit 4 Social Engineering and Insider Threats

Types of Social Engineering - Insider Attack - Preventing Insider Threats - Social engineering Targets and Defence Strategies

Unit 5 Legal Framework and Countermeasures in Cyber Security

IT Act, Hackers-Attacker-Countermeasures, Web Application Security, Counter Cyber Security Initiatives in India, Cyber Security Incident Handling, Cyber Security Assurance

Recommended Books:

1. Cyber Security and Cyber Laws Nilakshi Jain Wiley
2. Cyber Security Nina Godbole Wiley

Course: Business Intelligence

Course Objective: The objective of this course is to provide students with an understanding of business intelligence concepts, tools, and techniques. The course aims to develop students' skills in analyzing and interpreting data to support decision-making and business performance.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of business intelligence and data analytics.
2. Analyze and interpret data using business intelligence tools and techniques3. Design and develop data warehouses and data marts.
3. Apply data visualization techniques to present insights effectively.
4. Understand the ethical and legal considerations in business intelligence.

Course Content:

Unit 1 Introduction to Business Intelligence (BI)

Definition and scope of Business Intelligence, Components and architecture of BI systems, Data warehousing and data integration.

Unit 2 Data Analysis and Reporting

Data visualization techniques, Reporting tools and dashboards, Online Analytical Processing (OLAP).

Unit 3 Data Mining and Predictive Analytics

Data mining techniques and algorithms, Predictive modeling and forecasting, Pattern recognition and association rules.

Unit 4 Business Performance Management

Key Performance Indicators (KPIs), Balanced Scorecard approach, Performance monitoring and benchmarking.

Recommended Books:

1. "Business Intelligence: A Managerial Approach" by Ramesh Sharda, Dursun Delen, Efraim Turban, and David King.
2. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross.

Course: Understanding and Connecting with Environment

Course Objective: The "Understanding and Connecting with Environment" course aims to provide participants with a comprehensive understanding of the natural world and the intricate relationships between humans and their environment. The course seeks to raise environmental awareness, foster a sense of responsibility towards the planet, and empower individuals to make informed decisions for sustainable living.

Course Outcome: By the end of this course, students should be able to:

1. Develop a deep understanding of environmental concepts, ecosystems, and biodiversity.
2. Implement sustainable practices for responsible resource management and waste reduction.
3. Analyse the interconnectedness of species and ecosystems within the natural world.
4. Evaluate and address environmental issues such as climate change and habitat destruction.
5. Cultivate a sense of environmental responsibility and engage in ethical decision-making for sustainable living.

Course Content:

Unit 1 Understanding of Environment

Definition, scope and importance of Environment, Multidisciplinary nature of Environmental Sciences, Understanding of Ecology and Ecosystems, Ecological Succession and Ecosystem Services, Energy flow in an Ecosystem; Food Chain, Food Web and Ecological Pyramids, Human interaction with its Environment

Unit 2 Natural Resources and Biodiversity Conservation

Basic concept, types and values of Natural Resources, Resource Consumption, Restoration and Conservation Practices and Sustainable Development, Concept, values and distribution of Biodiversity and its linkages with culture, health and people, Threats to Biodiversity and Biodiversity conservation

Unit 3 Global Environmental issues

Environmental Pollution and Waste Management, Climate Change, Green House Effect and Global Warming, Radiations, Nuclear and Technological Hazards, Population Growth, Disaster, Pandemic and Human Health Risks

Unit 4 Environment and Society

Origin and Evolution of Human; Social, Cultural and Religious Structure and values of Environment, Traditional Wisdom, Indigenous/traditional Communities and Livelihood Security Industrial Society, Modernization and Adaptations to Natural and Anthropogenic variations, Environmental Movements, Environmental Ethics and Legislations, Connecting human society with conservation and management of water, energy, biodiversity, culture and heritage and waste management

Recommended Books:

1. Erach Bharucha, Environmental Studies. 2004.UGC and BVIEER Pune
2. Singh, J.S., Singh, S.P. and Gupta, S.R.2014. Ecology, Environmental Science and recourse Conservation. Anamaya Publishers

THIRD SEMESTER

Course: Data Structure & File Organization

Course Objective: The objective of this course is to familiarize students with fundamental data structures and their applications in solving computational problems. The course aims to develop students' skills in designing, implementing, and analysing various data structures.

Course Outcome: By the end of this course, students should be able to:

1. Understand the concepts of data structures and their importance in computing.
2. Implement and use common data structures such as arrays, linked lists, stacks, queues, trees, and graphs.
3. Analyze the time and space complexity of algorithms related to data structures.
4. Apply data structures to efficiently solve real-world problems.

Course Content:

Unit 1 Introduction to Data Structures

Overview of data organization and data types, Arrays, Linked Lists, and Stacks, Queues and their implementations.

Unit 2 Trees and Graphs

Binary Trees and Binary Search Trees, AVL Trees and Red-Black Trees, Graph representation and traversal.

Unit 3 Hashing

Introduction to hashing and its applications. Hash functions and collision resolution techniques. Hash tables and their implementation. Understanding the efficiency of hash-based data structures.

Unit 4 Sorting and Searching Algorithms

Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Linear and Binary Search.

Unit 5 File Organization and Indexing

Fundamentals of file organization: sequential, direct, and indexed. Primary and secondary indexing techniques. B+-tree index structure and its role in efficient data retrieval. Case studies of file organization in database systems.

Recommended Books:

1. "Data Structures and Algorithms in Java" by Robert Lafore.
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Course: Operating System

Course Objective: The objective of this course is to provide students with a comprehensive understanding of operating systems and their functionalities. The course aims to develop students' knowledge of process management, memory management, file systems, and device management in an operating system environment.

Course Outcome: By the end of this course, students should be able to:

1. Understand the basic concepts and components of operating systems.
2. Explain the functionalities and mechanisms of process management in an operating system.
3. Understand memory management techniques and algorithms.
4. Demonstrate knowledge of file systems and file management in an operating system.
5. Understand the principles of device management and I/O operations in an operating system.

Course Content:

Unit 1 Introduction to Operating Systems

Overview of operating systems and their role, Types of operating systems: batch processing, time-sharing, real-time, distributed, Operating system components and architecture

Unit 2 Process Management & Deadlock

Process concept and process control block, Process scheduling algorithms: FCFS, SJF, Round Robin, etc., Inter-Process communication and synchronization, Deadlock, Deadlock prevention, avoidance, detection, and recovery, Resource allocation graphs and deadlock handling algorithms, Banker's algorithm for resource allocation and safety

Unit 3 Memory Management

Memory hierarchy and memory management techniques, Paging, segmentation, and virtual memory, Memory allocation and deallocation strategies, Page Replacement algorithms

Unit 4 File Systems

File concepts and file organization, File operations: creation, deletion, read, write, File allocation methods: contiguous, linked, indexed

Unit 5 Device Management

I/O devices and device controllers, I/O operations and I/O scheduling, Disk scheduling algorithms

Recommended Books:

1. "Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne.
2. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos.

Course: Python Programming

Course Objective: This course is designed as the first course that introduces programming concepts using Python to Computer Science students. The course focuses on the development of Python programming to solve problems of different domains. It also introduces the concept of object- oriented programming

Course Outcome: By the end of this course, students should be able to:

1. Understand the basics of programming language
2. Develop, document, and debug modular Python programs.
3. Apply suitable programming constructs and built-in data structures to solve a problem.
4. Use and apply various data objects in Python.
5. Use classes and objects in application programs and handle files.

Unit 1 Introduction to Programming

Problem solving strategies; Structure of a Python program; Syntax and semantics; Executing simple programs in Python.

Unit 2 Creating Python Programs

Identifiers and keywords; Literals, numbers, and strings; Operators; Expressions; Input/output statements; Defining functions; Control structures (conditional statements, loop control statements, break, continue and pass, exit function), default arguments.

Unit 3 Built-in data structures

Mutable and immutable objects; Strings, built-in functions for string, string traversal, string operators and operations; Lists creation, traversal, slicing and splitting operations, passing list to a function; Tuples, sets, dictionaries and their operations.

Unit 4 Object Oriented Programming

Introduction to classes, objects and methods; Standard libraries

Unit 5 File and exception handling

File handling through libraries; Errors and exception handling.

Recommended Books:

3. "Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne.
4. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos.

Course: Modelling and Simulation

Course Objective: The objective of this course is to provide students with an understanding of modelling and simulation techniques and their applications in various domains. The course aims to develop students' skills in designing and implementing simulations to analyze and solve complex problems.

Course Outcome: By the end of this course, students should be able to:

1. Understand the concepts and principles of modelling and simulation.
2. Design and develop simulation models using appropriate simulation software or programming languages.
3. Apply statistical analysis techniques to evaluate simulation results.
4. Analyze and interpret simulation output to make informed decisions.
5. Apply modelling and simulation techniques to solve real-world problems in different domains.

Course Content:

Unit 1 Introduction to Modelling and Simulation

Overview of modeling and simulation concepts, Types of simulation models, Continuous and discrete event simulation.

Unit 2 Model Development and Validation

System dynamics modeling, Agent-based modeling, Validation and verification of simulation models.

Unit 3 Simulation Software and Tools

Popular simulation software: AnyLogic, Arena, etc., Simulation experiment design and analysis, Sensitivity analysis and optimization.

Unit 4 Case Studies in Simulation

Application of simulation in various domains, Simulation of manufacturing systems, Simulation of queuing systems.

Unit 5 Monte Carlo Simulation

Basics of Monte Carlo simulation, Generating random numbers, Monte Carlo simulation for risk analysis.

Recommended Books:

1. "Simulation Modeling and Analysis" by Averill M. Law and David Kelton.
2. "Discrete-Event System Simulation" by Jerry Banks, John S. Carson II, Barry L. Nelson, and David M. Nicol.

Course: Graph Theory

Course Objective: The objective of this course is to introduce students to the concepts and algorithms of graph theory and their applications in various domains. The course aims to develop students' skills in analysing and solving problems related to graphs and networks.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of graph theory and its terminology.
2. Analyze and represent problems using graph models.
3. Apply graph algorithms to solve problems such as shortest paths, minimum spanning trees, and network flows.
4. Apply graph theory concepts to solve real-world problems in different domains.
5. Understand the applications of graph theory in computer science, operations research, and other fields.

Course Content:

Unit 1 Introduction to Graph Theory

Basic concepts: Graphs, Vertices, Edges, Types of graphs: Directed, Undirected, Weighted, etc., Graph representation: Adjacency matrix, Adjacency list.

Unit 2 Graph Traversal and Shortest Paths

Breadth-First Search (BFS) and Depth-First Search (DFS), Dijkstra's algorithm for single-source shortest path, Bellman-Ford algorithm for single-source shortest path.

Unit 3 Spanning Trees and Connectivity

Minimum Spanning Tree (MST) algorithms: Prim's, Kruskal's, Connected components and Strongly Connected Components (SCC).

Unit 4 Network Flows and Matching

Maximum Flow and Minimum Cut problem, Bipartite matching and applications, Applications of graph theory in various fields.

Unit 5 Graph Algorithms

Topological sorting, Eulerian and Hamiltonian cycles, Traveling Salesman Problem (TSP), Introduction to NP-completeness.

Recommended Books:

1. "Introduction to Graph Theory" by Douglas B. West.
2. "Graph Theory and Its Applications" by Jonathan L. Grossand Jay Yellen.

Course: Informatics Cyber laws

Course Objective: The objective of this course is to provide students with an understanding of cyber laws and their implications in the field of informatics. The course aims to develop students' knowledge of legal frameworks, ethical considerations, and security measures related to information technology.

Course Outcome: By the end of this course, students should be able to:

1. Understand the legal frameworks and regulations governing cyberspace.
2. Identify and analyse legal issues related to information technology.
3. Evaluate the ethical implications of information technology practices.
4. Apply security measures to protect information systems and data.
5. Develop an understanding of the legal rights and responsibilities of individuals and organizations in cyberspace.

Course Content:

Unit 1 Introduction to Informatics Cyber laws

Overview of Cyber laws and their significance, Types of Cybercrimes and legal implications, Jurisdiction and challenges in Cyber law enforcement.

Unit 2 Cyber Security and Data Privacy

Cyber security threats and countermeasures, Data protection laws and regulations, Cybersecurity policies and practices.

Unit 3 Legal Framework for E-commerce and Intellectual Property

Laws related to e-commerce and electronic transactions, Intellectual Property laws and their application in the digital environment.

Unit 4 Privacy and Data Protection Laws

Privacy laws and regulations, Data breach notification and handling, GDPR and other global data protection laws.

Unit 5 Cyber Crime Investigation and Digital Forensics

Digital evidence and forensic techniques, Cybercrime investigation process, Role of digital forensics in legal proceedings.

Recommended Books:

1. "Cyber Law: Legal and Practical Considerations for Computer, E-commerce, and Intellectual Property" by Brett J. Trout.
2. "Cyberlaw: Management and Entrepreneurship" by Patricia L. Bellia, Paul Schiff Berman, and David G. Post.

Course: Indian Knowledge System-I

Course Objective: This course aims to provide participants with a comprehensive understanding of India's rich and diverse knowledge traditions, encompassing philosophy, literature, sciences, arts, and sustainable practices. Through the exploration of traditional wisdom and its contemporary relevance, this course seeks to foster appreciation, preservation, and responsible utilization of the Indian Knowledge System.

Course Outcome: By the end of this course, students should be able to:

1. Define and explain the concept and scope of Indian Knowledge System (IKS).
2. Evaluate the contributions of renowned Indian scholars to philosophy, literature, mathematics, astronomy, medicine, yoga, and other disciplines.
3. Analyze ancient Indian literature, including Vedas, Upavedas, Puranas, and Upanishads, for insights into cultural and philosophical heritage.
4. Investigate the socio-cultural linkages between traditional, tribal, and ethnic communities and their knowledge systems.
5. Examine myths, rituals, spiritual practices, and belief systems as integral components of Indian culture.

Course Content:

Unit 1 Introduction to Indian Knowledge System (IKS),

Definition, Concept and Scope of IKS, Definition, Concept and Scope of IKS, IKS based approaches on Knowledge Paradigms, IKS in ancient India and in modern India

Unit 2 IKS and Indian Scholars, Indian Literature

Philosophy and Literature (Maharishi Vyas, Manu, Kanad, Pingala, Parasar, Banabhatta, Nagarjuna and Panini), Mathematics and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan, Bhashkaracharya, Varahamihira and Brahmgupta), Medicine and Yoga (Charak, Susruta, Maharishi Patanjali and Dhanwantri), Sahitya (Vedas, Upvedas, Upavedas (Ayurveda, Dhanurveda, Gandharvaveda), Puran and Upnishad) and shad darshan (Vedanta, Nyaya.Vaisheshik, Sankhya, Mimamsa, Yoga, Adhyatma and Meditation), Shastra (Nyaya, vyakarana, Krishi, Shilp, Vastu, Natya and Sangeet)

Unit 3 Indian Traditional/tribal/ethnic communities, their livelihood and local wisdom

Geophysical aspects, Resources and Vulnerability, Resource availability, utilization pattern and limitations, Socio-Cultural linkages with Traditional Knowledge System, Tangible and intangible cultural heritage.

Unit 4 Unique Traditional Practices and Applied Traditional Knowledge

Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives, Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices, Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes, Vaidya (traditional health care system), Tantra-Mantra, Amchi Medicine System, Knowledge of dyeing, chemistry of dyes, pigments and chemicals

Unit 5 Protection, preservation, conservation and Management of Indian Knowledge System

Documentation and Preservation of IKS, Approaches for conservation and Management of nature and bio-resources, Approaches and strategies to protection and conservation of IKS

Recommended Books:

1. "Introduction To Indian Knowledge System: Concepts and Applications" by B. Mahadevan, Nagendra Pavana, Vinayak Rajat Bhat
2. "Traditional Knowledge System in India" by Amit Jha

FOURTH SEMESTER

Course: Computer Network

Course Objective: The objective of this course is to provide students with an understanding of data communication and computer networks. The course aims to develop students' knowledge of network protocols, architectures, and technologies.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of data communication and networking concepts.
2. Analyze and design network architectures and topologies.
3. Configure and troubleshoot network devices and protocols.
4. Apply network security measures to protect data transmission.
5. Understand emerging trends and technologies in data communication and networks.

Course Content:

Unit 1 Introduction to Data Communication & Networks

Components of a data communication system, Types of networks, Network topologies and communication protocols.

Unit 2 Network Architecture and OSI Model

Network architecture: client-server, peer-to-peer, OSI model layers and their functions, TCP/IP protocol suite.

Unit 3 Data Link Layer and Network Devices

Data link layer: framing, error detection, flow control, Network devices: switches, routers, bridges, etc., MAC addressing and Ethernet standards.

Unit 4 Network Security and Wireless Networks

Network security concepts: encryption, firewalls, VPN, Wireless networks and technologies.

Unit 5 Network Management and Emerging Technologies

Network management and monitoring tools, Cloud computing and virtualization, Internet of Things (IoT).

Recommended Books:

1. "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross.
2. "Data Communications and Networking" by Behrouz A.Forouzan and Sophia Chung Fegan.

Course: Database Management System

Course Objective: The objective of this course is to provide students with a comprehensive understanding of database management systems (DBMS) and their role in modern information management. The course aims to develop students' skills in designing, querying, and managing relational databases.

Course Outcome: By the end of this course, students should be able to:

1. Understand the concepts and principles of database management systems.
2. Design and create relational databases using SQL.
3. Query and manipulate data using SQL commands.
4. Apply normalization techniques to ensure data integrity.
5. Understand the principles of database administration and security.

Course Content:

Unit 1 Introduction to Database Management System

Overview of database systems and their components, Data models: hierarchical, network, relational, and object-oriented, Relational database concepts: tables, tuples, attributes, keys, etc.

Unit 2 Entity-Relationship Diagrams and Normalization

Entity-Relationship (ER) modeling, Functional dependencies and normalization, Normal forms: 1NF, 2NF, 3NF, BCNF.

Unit 3 Query Languages and Transactions

SQL fundamentals: SELECT, INSERT, UPDATE, DELETE, Joins and subqueries, ACID properties and transaction management.

Unit 4 Indexing and Concurrency Control

Indexing techniques: B-trees, hash indexes, etc., Concurrency control methods: locking, timestamping, etc., Database recovery and backup strategies.

Recommended Books:

1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan.
2. "SQL Performance Explained" by Markus Winand.

Course: R Programming

Course Objective: The R Programming course aims to provide participants with a comprehensive understanding of the R programming language and its applications in data analysis and statistical computing. Participants will start by gaining proficiency in the basics of R syntax, data structures, and control flow. As the course progresses, they will delve into data manipulation, visualization, and statistical analysis using R's extensive ecosystem of packages.

Course Outcome: By the end of this course, students:

1. be able to use and program in the programming language R
2. be able to use R to solve statistical problems
3. be able to implement and describe Monte Carlo the technology
4. be able to minimize and maximize functions using R

Course Content:

Unit 1: Getting Started with R

Introduction to R Programming, Setting Up R Studio, Basics of R Syntax, Storing Data with Variables, Displaying Data: Input and Output

Unit 2: Working with Data

Different Data Types in R, Organizing Data: Vectors and Matrices, Cleaning and Transforming Data, Basic Data Analysis, Creating Simple Charts

Unit 3: Coding Control and Functions

Making Choices with if and else, looping with for and while, Building Own Functions, Using Functions Effectively, Handling Mistakes: Debugging

Unit 4: Creating Visuals

Introduction to Data Visualization, Simple Plots with R, Customizing Graphics, Creating More Advanced Plots, Interactive Visualizations

Unit 5: Understanding Data Patterns

Exploring Data Stats, Basics of Hypothesis Testing, Understanding Regression, Introduction to Machine Learning, Practical Applications: Classification and Clustering

Recommended Books:

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth Singh, Vivek Mourya, Cengage Learning India.

Course: System Administrator

Course Objective: The objective of this course is to provide students with the knowledge and skills required to perform system administration tasks in various operating system environments. The course aims to develop students' understanding of system configuration, maintenance, security, and troubleshooting.

Course Outcome: By the end of this course, students should be able to:

1. Understand the roles and responsibilities of a system administrator.
2. Configure and manage operating system environments.
3. Implement security measures to protect system resources.
4. Perform system maintenance and troubleshooting tasks.
5. Apply best practices for system administration in different operating systems.

Course Content:

Unit 1 Introduction to System Administration

Role and responsibilities of a system administrator, Operating systems and their management, User and group management.

Unit 2 System Configuration and Maintenance

Installation and configuration of software and services, System updates and patch management, Disk management and file system maintenance.

Unit 3 Network Administration

Network configuration and troubleshooting, Firewall and network security, Remote access and VPN setup.

Unit 4 System Backup and Recovery

Data backup strategies and tools, Disaster recovery planning and implementation, System monitoring and performance tuning.

Unit 5 Cloud Computing and Virtualization

Introduction to cloud computing, Virtualization technologies (e.g., VMware, Hyper-V), Cloud services and their administration.

Recommended Books:

1. "UNIX and Linux System Administration Handbook" by Evi Nemeth, Garth Snyder, Trent R. Hein, and Ben Whaley.
2. "Windows Server Administration Fundamentals" by Microsoft Official Academic Course.

Course: Software Testing

Course Objective: The objective of this course is to provide students with an understanding of software testing principles, techniques, and methodologies. The course aims to develop students' skills in designing test cases, executing tests, and reporting defects.

Course Outcome: By the end of this course, students should be able to:

1. Understand the importance of software testing in the software development life cycle.
2. Apply different testing techniques and methodologies.
3. Design and execute test cases to verify software functionality.
4. Identify and report software defects effectively.
5. Understand the role of automated testing tools in software testing.

Course Content:

Unit 1 Introduction to Software Testing

Fundamentals of software testing, Testing life cycle and testing methodologies, Types of testing: functional, non-functional, etc.

Unit 2 Test Planning and Test Case Design

Test planning and test strategy development, Test case design techniques: black-box, white-box, etc., Test data preparation and test environment setup.

Unit 3 Test Execution and Defect Management

Test execution and defect reporting, Test automation and test scripts, Defect management and tracking.

Unit 4 Performance and Security Testing

Performance testing: load, stress, and scalability testing, Security testing: vulnerabilities and penetration testing, Usability testing and user experience evaluation.

Unit 5 Test Automation Tools and Emerging Trends

Introduction to test automation tools (e.g., Selenium, JUnit), Continuous integration and continuous testing, Emerging trends in software testing.

Recommended Books:

1. "Foundations of Software Testing" by Dorothy Graham, Erik Van Veenendaal, Isabel Evans, and Rex Black.
2. "The Art of Software Testing" by Glenford J. Myers.

Course: Software Engineering

Course Objective: The objective of this course is to provide students with an understanding of software engineering principles, processes, and methodologies. The course aims to develop students' skills in software requirements analysis, design, implementation, and testing.

Course Outcome: By the end of this course, students should be able to:

1. Understand the principles and practices of software engineering.
2. Apply software engineering processes and methodologies to develop software systems.
3. Perform requirements analysis and software design.
4. Implement software using appropriate programming languages and development tools.
5. Apply software testing and quality assurance techniques.

Course Content:

Unit 1 Introduction to Software Engineering

Software development life cycle (SDLC) models, Requirements engineering and analysis, Software project management.

Unit 2 Software Design and Architecture

Software design principles and patterns, Architectural styles: layered, client-server, etc., UML and design documentation.

Unit 3 Software Development Methodologies

Agile software development: Scrum, Kanban, etc., Waterfall and iterative development approaches, Quality assurance and software testing.

Unit 4 Software Maintenance and Configuration Management

Software maintenance and its challenges, Version control and configuration management, Software re-engineering and refactoring.

Unit 5 Software Metrics and Emerging Practices

Software metrics and measurement, Software documentation and knowledge management, Emerging practices in software engineering: DevOps, etc.

Recommended Books:

1. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman.
2. "Software Engineering: Principles and Practice" by Hans van Vliet.

FIFTH SEMESTER

Course: Compiler Design

Course Objective: The course aims to provide participants with a comprehensive understanding of compiler construction principles, enabling them to design, implement, and optimize compilers for programming languages.

Course Outcome: By the end of this course, students should be able to:

1. Explain the phases of compilation and their role in transforming source code.
2. Define context-free grammars and construct parse trees.
3. Perform semantic analysis to catch programming errors.
4. Apply optimization techniques to improve code efficiency.
5. Implement code generation for various target architectures.

Course Content:

Unit 1 Introduction to Compiler Design

Introduction to compilers: Role, importance, and phases of compilation. Overview of lexical analysis, syntax analysis, semantic analysis, code generation, and optimization. Compiler architecture and its components.

Unit 2 Syntax Analysis and Parsing Techniques

Formal language grammars: Regular, context-free, and context-sensitive grammars. Parsing techniques: Top-down parsing (LL parsing) and bottom-up parsing (LR parsing). Construction of parse trees and abstract syntax trees.

Unit 3 Semantic Analysis and Type Checking

Semantic analysis: Role and importance in error detection and correction. Symbol tables: Organization, scope, and management of symbols. Type systems and type checking: Static and dynamic type checking, type inference.

Unit 4 Code Generation and Optimization

Intermediate code generation: Three-address code, quadruples, and intermediate representations. Basic block representation and control flow graphs. Code optimization techniques: Constant folding, common subexpression elimination, loop optimization.

Unit 5 Compiler Design Tools and Debugging

Lexical analysis using tools like Lex. Syntax analysis using tools like Yacc (Bison). Debugging techniques for compilers and tools. Hands-on exercises to implement a basic compiler using Lex and Yacc.

Recommended Books:

1. **"Modern Compiler Implementation in C/Java/ML"** by Andrew W. Appel
2. **"Engineering a Compiler"** by Keith D. Cooper and Linda Torczon.

Course: Computer Graphics

Course Objective: The objective of this course is to provide students with a solid foundation in computer graphics principles and techniques. The course aims to develop students' skills in designing and rendering 2D and 3D graphics, understanding graphics algorithms, and applying graphics concepts in interactive applications.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of computer graphics and its applications.
2. Design and render 2D and 3D graphics using appropriate tools and libraries.
3. Implement graphics algorithms for transformations, rasterization, and shading.
4. Apply computer graphics concepts in interactive applications and virtual environments.
5. Analyse and optimize graphics performance in real-time applications.

Course Content:

Unit 1 Introduction to Computer Graphics

Overview of computer graphics and its applications, Graphics hardware and software, Graphics pipeline and rendering techniques

Unit 2 2D Graphics and Transformations

2D coordinate systems and transformations, Clipping and windowing techniques, 2D viewing and projection transformations

Unit 3 3D Graphics and Transformations

3D coordinate systems and transformations, Viewing and projection in 3D space, Hidden surface removal and visibility algorithms

Unit 4 Rasterization and Shading

Rasterization techniques: scanline, polygon filling, Shading models and illumination techniques, Texture mapping and image-based rendering

Unit 5 Interactive Graphics and Virtual Environments

User interaction techniques in computer graphics, Virtual reality and augmented reality concepts, Real-time graphics programming and optimization

Recommended Books:

1. "Computer Graphics: Principles and Practice" by John F. Hughes, Andries van Dam, James D. Foley, Steven K. Feiner, and Kurt Akeley.
2. "OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5" by John Kessenich, Graham Sellers, and Dave Shreiner.

Course: Multimedia Application

Course Objective: The objective of this course is to provide students with an understanding of multimedia technology and its applications in various domains. The course aims to develop students' skills in designing and developing multimedia content, integrating multimedia elements, and applying multimedia technologies.

Course Outcome: By the end of this course, students should be able to:

1. Understand the concepts and components of multimedia technology.
2. Design and develop multimedia content using appropriate tools and techniques.
3. Integrate various multimedia elements such as text, images, audio, and video.
4. Apply multimedia technologies in interactive applications and presentations.
5. Evaluate and optimize multimedia content for different platforms and devices.

Course Content:

Unit 1 Introduction to Multimedia Technology

Overview of multimedia technology and its components, Multimedia elements: text, images, audio, video, Multimedia file formats and compression techniques

Unit 2 Multimedia Authoring Tools and Techniques

Multimedia authoring software and tools, Design principles for multimedia content, Multimedia scripting and programming languages

Unit 3 Image and Video Processing in Multimedia

Image and video acquisition and editing, Image and video compression techniques, Image and video enhancement and effects

Unit 4 Audio and Animation in Multimedia

Digital audio concepts and formats, Audio editing and processing techniques, Animation principles and techniques

Unit 5 Multimedia Integration and Application Development

Integration of multimedia elements in interactive applications, Multimedia in web design and development, Optimization and delivery of multimedia content

Recommended Books:

1. "Multimedia: Making It Work" by Tay Vaughan.
2. "Multimedia Systems: Algorithms, Standards, and Industry Practices" by Parag Havaldar and Gerard Medioni.

Course: ASP.Net

Course Objective: The ASP .NET course aims to equip student with a strong foundation in developing dynamic web applications using the ASP .NET framework. Through the course, participants will learn how to design and build interactive web pages, utilizing languages like C# for server-side logic. They will grasp concepts of model-view-controller (MVC) architecture, essential for creating scalable and maintainable web applications.

Course Outcome: By the end of this course, students should be able to:

1. To learn fundamentals of. net framework
2. To enrich knowledge about Windows Forms, Controls and ASP.NET based applications.
3. To acquire skills to create web-based applications and Reports using.net technologies

Course Content:

Unit 1 Introduction to .NET Framework and Managed Code

Introduction to .NET Framework: Managed Code and the CLR- Intermediate Language, Metadata and JIT Compilation - Automatic Memory Management

Unit 2 Language Concepts, CLR, and Framework Class Library

Language Concepts and the CLR: Visual Studio .NET - Using the .NET Framework. The Framework Class Library: NET objects - ASP .NET - .NET web services – Windows Forms

Unit 3 ASP.NET Features and Web Services

ASP.NET Features: Change the Home Directory in IIS - Add a Virtual Directory in IIS- Set a Default Document for IIS - Change Log File Properties for IIS - Stop, Start, or Pause a Web Site.

Unit 4 Web Controls and Creating Web Forms

Creating Web Controls: Web Controls - HTML Controls, Using Intrinsic Controls, Using Input Validation Controls, Selecting Controls for Applications - Adding web controls to a Page. Creating Web Forms: Server Controls - Types of Server Controls - Adding ASP.NET Code to a Page.

Recommended Books:

1. "Professional ASP.NET 4.5 in C# and VB" by Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, and Scott Hanselman
2. "ASP.NET Core 5 for Beginners" by Jonas Fagerberg

Course: Pattern Recognition

Course Objective: This course aims to provide students with a comprehensive understanding of pattern recognition and classification techniques. Starting with an introduction to the significance of pattern recognition, feature extraction, and classification methods, it covers the spectrum of supervised, unsupervised, and semi-supervised learning. The course delves into theoretical foundations, including Bayes Decision Theory, discriminant functions, and Gaussian PDF

Course Outcome: By the end of this course, students should be able to:

1. Identify areas where Pattern Recognition and Machine Learning can offer a solution.
2. Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems
3. Describe genetic algorithms, validation methods and sampling techniques
4. Describe and model data to solve problems in regression and classification
5. Implement learning algorithms for supervised tasks.

Course Content:

Unit 1 Introduction to Pattern Recognition and Classification

Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions.

Unit 2 Dimensionality Reduction Techniques

Introduction, Basis Vectors, The Karhunen Loeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA.

Unit 3 Probability Estimation and Bayesian Inference

Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule.

Unit 4 Linear Discriminant Analysis and Perceptron Algorithm

Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS Algorithm, Sum of Error Estimate.

Unit 5 Neural Networks and Clustering Concepts

The XOR Problem, The two Layer Perceptron, Three Layer Perceptron, Back propagation Algorithm, Basic Concepts of Clustering, Introduction to Clustering, Proximity Measures.

Recommended Books:

1. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
2. "Pattern Recognition: Principles" by Joachim M. Buhmann

Course: SQL/PL-SQL

Course Objective: The objective of this course is to provide students with a comprehensive understanding of SQL (Structured Query Language) and PL/SQL (Procedural Language/SQL) for database management. The course aims to develop students' skills in querying, manipulating, and managing databases using SQL and PL/SQL.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of SQL and relational database management systems.
2. Write SQL queries to retrieve, update, and delete data from databases.
3. Use SQL to create and modify database tables, views, and indexes.
4. Develop PL/SQL programs for procedural database operations.
5. Apply database optimization techniques using SQL and PL/SQL.

Course Content:

Unit 1 Introduction to SQL

Overview of SQL and its role in database management, Basic SQL syntax and data manipulation commands, Retrieving data using SELECT statements

Unit 2 Advanced SQL Queries

Joins and subqueries in SQL, Aggregate functions and grouping data, Manipulating data with INSERT, UPDATE, and DELETE statements

Unit 3 Database Design and Data Definition Language (DDL)

Database design principles and normalization, Creating and modifying database tables using DDL, Creating views, indexes, and constraints

Unit 4 Introduction to PL/SQL

Procedural constructs and control flow in PL/SQL, Variables, data types, and operators in PL/SQL, Writing PL/SQL blocks and procedures

Unit 5 Advanced PL/SQL Programming

Cursors and exception handling in PL/SQL, Stored procedures, functions, and triggers. Database optimization techniques using SQL and PL/SQL

Recommended Books:

1. "SQL in 10 Minutes a Day" by Ben Forta.
2. "Oracle PL/SQL Programming" by Steven Feuerstein.

SIXTH SEMESTER

Course: Cryptography & Network Security

Course Objective: The objective of this course is to provide students with a comprehensive understanding of network security concepts and techniques. The course aims to develop students' skills in identifying network vulnerabilities, implementing security measures, and ensuring the confidentiality, integrity, and availability of networked systems.

Course Outcome: By the end of this course, students should be able to:

1. Understand the principles and concepts of network security.
2. Identify potential security threats and vulnerabilities in networked systems.
3. Implement security measures to protect network infrastructure.
4. Apply encryption and authentication techniques to secure network communication.
5. Analyze and respond to security incidents in networked environments.

Course Content:

Unit 1 Introduction to Network Security

Basics of network security: confidentiality, integrity, availability, Security threats and vulnerabilities, Security controls and defense mechanisms.

Unit 2 Cryptography and Encryption

Cryptographic algorithms and techniques, Symmetric and asymmetric encryption, Digital signatures and certificates.

Unit 3 Network Security Protocols

Secure Socket Layer (SSL) and Transport Layer Security (TLS), IPsec and Virtual Private Networks (VPNs), Secure Shell (SSH) and Secure File Transfer Protocol (SFTP).

Unit 4 Network Access Control and Firewalls

Access control mechanisms: authentication, authorization, accounting, Network firewalls: types and configurations, Intrusion Detection and Prevention Systems (IDPS).

Unit 5 Network Security Management and Emerging Technologies

Security policy and risk management, Security incident response and handling, Emerging technologies in network security: AI-based security, etc.

Recommended Books:

1. "Network Security: Private Communication in a Public World" by Charlie Kaufman, Radia Perlman, and Mike Speciner.
2. "Principles of Computer Security: CompTIA Security+ and Beyond" by Wm. Arthur Conklin, Greg White, Dwayne Williams, Chuck Cothren, and Roger L. Davis.

Course: Design and Analysis of Algorithm

Course Objective: The objective of this course is to provide students with a solid foundation in algorithm analysis and design techniques. The course aims to develop students' skills in solving computational problems, analysing algorithm complexity, and designing efficient algorithms.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of algorithm analysis and design.
2. Analyse the time and space complexity of algorithms.
3. Apply algorithmic techniques to solve computational problems.
4. Design and implement efficient algorithms for real-world scenarios.
5. Evaluate and compare different algorithmic approaches for problem solving.

Course Content:

Unit 1 Introduction to Algorithms

Basics of algorithms and problem-solving techniques, Asymptotic analysis: Big-O notation, time and space complexity, Algorithm design paradigms.

Unit 2 Sorting and Searching Algorithms

Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Linear and Binary Search.

Unit 3 Divide and Conquer Algorithms

Binary search, Merge sort, Closest pair problem, Karatsuba multiplication.

Unit 4 Dynamic Programming and Greedy Algorithms

Fibonacci series, Knapsack problem, Dijkstra's algorithm, Prim's algorithm, Huffman coding.

Unit 5 Graph Algorithms and NP-Completeness

Depth-First Search (DFS) and Breadth-First Search (BFS), Shortest path algorithms, Introduction to NP-Completeness and the P vs. NP problem.

Recommended Books:

1. "Introduction to the Design and Analysis of Algorithms" by Anany Levitin.
2. "Algorithm Design Manual" by Steven S. Skiena.

Course: E-Commerce

Course Objective: The objective of this course is to provide students with an understanding of e-commerce principles, technologies, and strategies. The course aims to develop students' skills in designing, developing, and managing e-commerce systems for online business operations.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of e-commerce and its impact on business.
2. Analyze and evaluate different e-commerce models and technologies.
3. Design and develop e-commerce websites and applications.
4. Apply security and privacy measures in e-commerce systems.
5. Understand the legal and ethical considerations in e-commerce.

Course Content:

Unit 1 Introduction to E-Commerce

Types of E-Commerce, E-Commerce business models. E-Commerce Framework

Unit 2 E-Commerce Infrastructure and Payment Systems

Electronic payment systems and security, Mobile payment and digital wallets.

Unit 3 E-Commerce Website Development

Building E-Commerce websites, Product catalogue management and online shopping cart, Customer registration and authentication.

Unit 4 E-Commerce Security and Legal Issues

Web security in E-Commerce, Legal and regulatory issues in E-Commerce, Consumer protection and privacy.

Unit 5 E-Commerce Marketing and Emerging Trends

E-Commerce marketing strategies, Social media and E-Commerce, Emerging trends in E-Commerce.

Recommended Books:

1. "E-Commerce 2021" by Kenneth C. Laudon and Carol Traver.
2. "E-Commerce: Business, Technology, Society" by Kenneth C. Laudon and Carol Guercio Traver.

Course: Image Processing

Course Objective: This course introduces students to the fundamentals of image processing, and various image transforms, image restoration techniques, image compression and segmentation used in image processing

Course Outcome: By the end of this course, students should be able to:

1. Identify the fundamental elements of an image and describe the need of digital image processing.
2. Understand different types of image transformation techniques and their properties.
3. Use various noise models and calculate the values for restoration and degradation models.
4. Analyze and evaluate various image compression techniques.
5. Integrate and Demonstrate various Image Transformation and Segmentation Techniques

Course Content:

Unit 1 Introduction to Digital Image Processing

The origins of Digital Image Processing, Examples of Digital Image Processing application, Fundamental steps in Digital Image processing, Components of Image Processing system Fundamentals: Elements of Visual Perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels, Linear and Nonlinear Operations

Unit 2 Image Enhancement in the spatial domain

Background, some basic gray level transformation, Introduction of Histogram processing, Enhancement using Arithmetic/Logic operations, Basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters, Image Enhancement in the Frequency Domain: Introduction.

Unit 3 Image Restoration

Model of the Image Degradation/Restoration process, Noise Models, Restoration in the presence of noise only spatial filtering, Inverse filtering, Minimum Mean Square Error (Wiener) filtering, Geometric mean filter, Geometric Transformations, Image Compression: Fundamentals, Lossy Compression, Lossless Compression, Image Compression models, Error-free Compression: Variable length coding, LZW coding, Bit plane coding, Run length coding, Introduction to JPEG.

Unit 4 Morphology

Dilation, Erosion, Opening and Closing, Hit-and Miss transforms, Morphological Algorithms: Boundary Extraction, Region filling, Extraction of connected components, Convex Hull

Unit 5 Image Segmentation

Definition, characteristics of segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region based segmentation. Introduction to Representation and Description, Introduction to Object Recognition.

Recommended Books:

1. Digital Image Processing: Rafael C. Gonzalez and Richard E.Woods. Addision Wesley.
2. Fundamentals of Digital Image Processing. Anil K. Jain, PHI.

Course: Parallel Programming

Course Objective: This course aims to provide students with a comprehensive understanding of parallel computing. Starting with the need for high-speed computing and historical context, it explores diverse strategies to enhance computer speed through temporal and data parallelism. Students will grasp the structure and classifications of parallel computers, including vector supercomputers, shared memory systems, and distributed architectures. The course delves into operating systems for parallel environments, covering resource management, synchronization, and performance evaluation. Additionally, it introduces the concept of GPU computing and CUDA, discussing applications and development tools.

Course Outcome: By the end of this course, students should be able to:

1. Solve the Problems in Parallel
2. Have knowledge on Different Structures of Parallel Computers
3. Understand the Performance Evaluation of Parallel Computers
4. Get acquaintance on CUDA
5. Develop Parallel Programs in CUDA C

Course Content:

Unit 1 Introduction to Parallel Computing and Speed Enhancement

Need of High-Speed Computing, How we increase the Speed of Computers, History of Parallel Computers, Solving problems in parallel: Utilizing Temporal Parallelism, Utilizing Data Parallelism, Comparison of Temporal and Data Parallel Processing, Data Parallel Processing with Specialized Processors.

Unit 2 Structure and Classification of Parallel Computers

Structure of parallel computers: A Generalized Structure of a Parallel Computer, Classification of Parallel Computers, Vector Computers, A Typical Vector Super Computer, Array Processors, Shared Memory Parallel Computers, Distributed Shared Memory Parallel Computers, Message Passing Parallel Computers.

Unit 3 Operating Systems and Performance Evaluation for Parallel Computers

Operating systems for parallel computers: Resource Management, Process Management, Process Synchronization, Inter-process Communication, Memory Management, Input/output (Disk Arrays), Basics of Performance Evaluation, Performance Measurement Tools.

Unit 4 Computer Unified Device Architecture (CUDA)

Computer unified device architecture: The age of parallel processing, The rise of GPU computing, CUDA, Applications of CUDA, Development Environment-CUDA Enabled Graphics Processors, NVIDIA Device driver, CUDA Development Tool kit, Standard C compiler.

Unit 5 Introduction to CUDA C and Parallel Programming

Introduction to CUDA C: First program, Querying Devices, Using Device Properties, Parallel Programming in CUDA C: CUDA Parallel Programming- Summing Vectors program

Recommended Books:

1. Parallel Computers Architecture and Programming, V. Rajaraman, C. Siva Ram Murthy,PHI.
2. CUDA By Example, Jason Sanders, Edward Kandrot, Addison_Wesley.

Course: Data Compression

Course Objective: This course is designed to provide a comprehensive understanding of data compression techniques. Beginning with an exploration of the fundamental need for compression and the distinction between lossless and lossy methods, the course covers key metrics and Shannon's Source Coding Theorem. Participants will delve into various compression techniques, including Run-Length Encoding, Huffman and Arithmetic Coding, as well as dictionary-based methods like LZW and Burrows-Wheeler Transform. Lossy compression techniques involving Transform Coding, such as DCT and Quantization, are explored, along with standards like JPEG and MPEG for multimedia. Additionally, audio compression principles and techniques, including MP3 and AAC, are covered. Advanced topics include multimedia compression formats, video standards like H.264 and H.265, and error resilience strategies.

Course Outcome: By the end of this course, students should be able to:

1. To gain a fundamental understanding of data compression methods for text, images, and video, and related issues in the storage, access, and use of large data sets
2. To select, giving reasons that are sensitive to the specific application and particular circumstance, most appropriate compression techniques for text, audio, image and video information
3. To illustrate the concept of various algorithms for compressing text, audio, image and video information.
4. To understand various Distortion criterions.
5. To illustrate the Advantages of Vector Quantization over Scalar Quantization.

Course Content:

Unit 1: Introduction to Data Compression

Need for Data Compression, Lossless vs. Lossy Compression, Compression Metrics: Bit Rate, Compression Ratio, etc., Shannon's Source Coding Theorem, Information Theory Basics

Unit 2: Lossless Compression Techniques

Run-Length Encoding (RLE), Huffman Coding, Arithmetic Coding, Dictionary-based Compression: LZW Algorithm, Burrows-Wheeler Transform and Move-to-Front Coding

Unit 3: Lossy Compression Techniques

Transform Coding: Discrete Cosine Transform (DCT), Quantization Techniques, JPEG Compression Standard, Wavelet Transform and JPEG2000, Video Compression: MPEG Standards

Unit 4: Audio Compression

Audio Coding Principles, Pulse Code Modulation (PCM), Audio Compression Standards: MP3 and AAC, Speech Compression Techniques, Adaptive Differential Pulse Code Modulation (ADPCM)

Unit 5: Multimedia and Advanced Compression

Image Compression: PNG, GIF, and WebP, Video Compression: H.264/AVC and H.265/HEVC, Lossy Text Compression: LZ77 and LZ78, Fractal Compression, Error Resilience and Error Concealment in Compression

Recommended Books:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers
2. Elements of Data Compression,Drozdek, Cengage Learning

SEVENTH SEMESTER

Course: Artificial Intelligence

Course Objective: The objective of this course is to provide students with an understanding of artificial intelligence and its various techniques and applications. The course aims to develop students' skills in designing and implementing AI systems, solving AI problems, and exploring the ethical considerations of AI.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts and techniques of artificial intelligence.
2. Apply AI algorithms and methodologies to solve real-world problems.
3. Design and develop AI systems using appropriate tools and frameworks.
4. Evaluate and optimize AI models for performance and accuracy.
5. Recognize and analyse the ethical implications of AI technologies.

Course Content:

Unit 1 Introduction to Artificial Intelligence

Overview of artificial intelligence and its applications, History and foundations of AI, Ethical considerations in AI development and deployment

Unit 2 Problem Solving and Search Algorithms

Problem-solving techniques and algorithms, Search algorithms: uninformed and informed search, Heuristic search and optimization algorithms

Unit 3 Knowledge Representation and Reasoning

Knowledge representation techniques: logic, semantic networks, and frames, Inference mechanisms and reasoning algorithms, Uncertainty and probabilistic reasoning in AI

Unit 4 Machine Learning and AI Models

Introduction to machine learning algorithms, Supervised, unsupervised, and reinforcement learning, Deep learning and neural networks for AI applications

Unit 5 AI Systems and Applications

Natural language processing and understanding, Computer vision and image recognition, AI in robotics and autonomous systems

Recommended Books:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.

Course: Cloud Computing

Course Objective: The objective of this course is to provide graduate students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations.

Course Outcome: By the end of this course, students should be able to:

1. Understand the key dimensions of the challenges and benefits of Cloud Computing.
2. Describe the principles of Parallel and Distributed Computing and evolution of cloud computing from existing technologies
3. Implement different types of Virtualization technologies and Service Oriented Architecture systems.
4. Choose among various cloud technologies for implementing applications.
5. Install and use current cloud technologies.

Course Content:

Unit 1 Introduction to Cloud Computing

Introduction: Cloud-definition, benefits, usage scenarios, History of Cloud Computing, Cloud Architecture, Types of Clouds, Players in Cloud Computing, issues in Clouds

Unit 2 Types of Cloud Services and Providers

Types of Cloud services, Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services. Service Providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

Unit 3 Collaborating Using Cloud Services

Collaborating Using Cloud Services Email Communication over the Cloud, CRM Management, Project Management, Event Management, Task Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks and Groupware

Unit 4 Virtualization for Cloud and Cloud Security

Virtualization for Cloud Need for Virtualization, Pros and cons of Virtualization, Types of Virtualizations, System VM, Process VM, Virtual Machine monitor, Virtual machine properties, HLL VM, Hypervisors, Xen, KVM, VMWare, Virtual Box, Hyper-V

Unit 5 Future Trends in Mobile Communication

Cloud Security: Infrastructure Security- Network level security, Host level security, Application-level security, Data security, Authentication in cloud computing, Cloud security challenges.

Recommended Books:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood
2. "Cloud Computing: A Practical Approach" by Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter

Course: Fundamental of Data Science

Course Objective: The objective of this course is to introduce students to the fundamentals of data science and its applications in various domains. The course aims to develop students 'knowledge and skills in data manipulation, data analysis, and data visualization techniques.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts and principles of data science.
2. Apply data manipulation techniques using appropriate tools and libraries.
3. Analyse and visualize data to extract insights and make data-driven decisions.
4. Apply statistical methods and machine learning algorithms to analyse data.
5. Communicate data findings effectively through data visualization and storytelling.

Course Content:

Unit 1 Introduction to Data Science

Overview of data science and its significance, Data science process and lifecycle, Ethical considerations in data science

Unit 2 Data Manipulation and Preparation

Data acquisition and data cleaning techniques, Data pre-processing: handling missing data, outliers, and data normalization, Exploratory data analysis and data profiling

Unit 3 Data Analysis and Statistical Methods

Descriptive statistics and summary measures, Hypothesis testing and statistical inference, Regression analysis and correlation

Unit 4 Machine Learning for Data Science

Introduction to machine learning algorithms, Supervised and unsupervised learning techniques, Model evaluation and selection

Unit 5 Data Visualization and Communication

Principles of data visualization and visual perception, Data visualization techniques and tools, Communicating data findings and storytelling

Recommended Books:

1. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney.
2. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett.

Course: Internet of Things

Course Objective: The course aims to equip the students to understand the basics of Internet of Things (IoT) and its applications. IoT primarily refers to the connected and smarter world having physical and virtual objects with some unique identities. IoT applications spans across domains of industrial control, retail, energy, agriculture, etc.

Course Outcome: By the end of this course, students should be able to:

1. Understand how connected devices work together to update other applications.
2. Acquire knowledge to interface sensors and actuator with microcontroller-based Arduino platform.
3. Writing C programs in Arduino IDE.
4. Build IoT based applications and understand how data flows between things.

Course Content:

Unit 1 Introduction to IoT and IoT Design

Introduction - Overview of Internet of Things (IoT), the characteristics of devices and applications in IoT ecosystem, building blocks of IoT, Various technologies making up IoT ecosystem, IoT levels, IoT design methodology, The Physical Design/Logical Design of IoT, Functional blocks of IoT and Communication Models.

Unit 2 Controlled Systems and Connectivity Models

Working of Controlled Systems, Real-time systems with feedback loop e.g., thermostat in refrigerator, AC, etc. Connectivity models – TCPIP versus OSI model, different type of modes using wired and wireless methodology, the process flow of an IoT application

Unit 3 Sensors, Actuators, and Microcontrollers

Sensor - Measuring physical quantities in digital world e.g., light sensor, moisture sensor, temperature sensor, etc. Actuator – moving or controlling system e.g., DC motor, different type of actuators Controller – Role of microcontroller as gateway to interfacing sensors and actuators, microcontroller vs microprocessor, different type of microcontrollers in embedded ecosystem.

Unit 4 Embedded "C" Language Basics and Control Structures

Building IoT applications: Embedded "C" Language basics - Variables and Identifiers, Built-in Data Types, Arithmetic operators and Expressions, Constants and Literals, assignment. Conditional Statements and Loops - Decision making using Relational Operators, Logical Connectives - conditions, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement.

Unit 5 Interfacing Sensors, Functions, and Practical Implementations

Arrays – Declaring and manipulating single dimension arrays Functions - Standard Library of C functions in Arduino IDE, Prototype of a function: Formal parameter list, Return Type, Function call. Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135. Display the data on Liquid Crystal Display (LCD), interfacing keypad, Serial communication – interfacing HC-05(Bluetooth module) Control/handle 220v AC supply – interfacing relay module.

Recommended Books:

1. Internet Of Things: A Hands-On Approach by Arsheep Bahga (Author), Vijay Madisetti (Author)
2. Internet Of Things: Key Applications and Protocols by Olivier Hersent and David Boswarthick, John Wiley

Course: Machine Learning

Course Objective: The course aims at introducing the basic concepts and techniques of machine learning so that a student can apply machine learning techniques to a problem at hand.

Course Outcome: By the end of this course, students should be able to:

1. Differentiate between supervised and unsupervised learning tasks.
2. Differentiate between linear and non-linear classifiers.
3. Describe theoretical basis of SVM
4. Implement various machine learning algorithms learnt in the course.

Course Content:

Unit 1 Introduction to Machine Learning and Types

Introduction: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning, Unsupervised learning, Reinforcement learning

Unit 2 Decision Tree Learning

Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

Unit 3 Bayesian Learning

Bayes theorem and concept learning, Bayes optimal classifier, Gibb's algorithms, Naive Bayes Classifier, Bayesian belief networks, The EM algorithm.

Unit 4 Artificial Neural Network

Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, dynamically modifying network structure.

Unit 5 Genetic Algorithms and Data Mining Techniques

Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms. Data Mining Techniques for Analysis: Classification: Decision tree induction, Bayes classification, Rule-based classification, Support Vector Machines, Classification Using Frequent Patterns, k-Nearest-Neighbour, Fuzzy-set approach Classifier, Clustering: K-Means, k-Medoids, Agglomerative versus Divisive Hierarchical Clustering Distance Measures in Algorithmic Methods, Mean-shift Clustering

Recommended Books:

1. Mitchell T.M., Machine Learning, McGraw Hill
2. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag

Course: Data Analytics

Course Objective: The Data Analytics course is designed to equip students with the skills and knowledge necessary to extract meaningful insights and make informed decisions from large and complex datasets. Participants will learn fundamental concepts of data analysis, including data preprocessing, visualization, and statistical techniques. The course will cover various tools and programming languages commonly used in data analytics, enabling participants to clean, transform, and analyse data effectively.

Course Outcome: By the end of this course, students should be able to:

1. Handle missing data in the real-world data sets by choosing appropriate methods.
2. Summarize the data using basic statistics. Visualize the data using basic graphs and plots.
3. Identify the outliers if any in the data set.
4. Choose appropriate feature selection and dimensionality reduction

Course Content:

Unit 1 Data Analytics Lifecycle and Exploratory Data Analysis

Module content: Data Analytics lifecycle, Exploratory Data Analysis (EDA) - Definition, Motivation, Steps in data exploration, the basic data types Data Type Portability, Module content: Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, Improving the accuracy of analysis

Unit 2 Handling Missing Data and Bayesian Estimation

Pre-processing Bayesian Estimation: Introduction to Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data

Unit 3 Data Summarization and Visualization

Data Summarization & Visualization: Module content: Statistical data elaboration, 1-D Statistical, data analysis, 2-D Statistical data Analysis, ND Statistical data analysis

Unit 4 Feature Subset Selection and Algorithms

Feature Subset Selection: Module content: Feature selection algorithms: filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features election

Unit 5 Dimensionality Reduction Techniques

Dimensionality Reduction: Module content: Introduction, Principal Component Analysis (PCA), Kernel PCA, Canonical Correlation Analysis, Factor Analysis, Multi-dimensional scaling, Correspondence Analysis

Recommended Books:

1. Charu C. Aggarwal, “Data Mining The Text book”, Springer, 2015.
2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.

EIGHTH SEMESTER

Course: Deep Learning

Course Objective: The objective of this course is to provide students with an in-depth understanding of deep learning principles, algorithms, and applications. The course aims to develop students' skills in designing and implementing deep neural networks for solving complex machine learning tasks.

Course Outcome: By the end of this course, students should be able to:

1. Understand the principles and architectures of deep neural networks.
2. Implement and train deep neural networks using appropriate frameworks and libraries.
3. Apply deep learning techniques to solve real-world problems in various domains.
4. Evaluate and optimize deep learning models for performance and accuracy.
5. Stay updated with the latest advancements and trends in deep learning research.

Course Content:

Unit 1 Introduction to Deep Learning

Overview of deep learning concepts and its significance, Basics of neural networks and gradient-based optimization, Activation functions and loss functions in deep learning

Unit 2 Deep Neural Network Architectures

Feedforward neural networks and backpropagation algorithm, Convolutional neural networks (CNNs) for image processing, Recurrent neural networks (RNNs) for sequential data analysis

Unit 3 Deep Learning Frameworks and Libraries

Introduction to popular deep learning frameworks (e.g., TensorFlow, PyTorch), Building and training deep neural networks using frameworks, Transfer learning and pre-trained models

Unit 4 Advanced Deep Learning Techniques

Generative adversarial networks (GANs) for data generation, Autoencoders and variational autoencoders (VAEs), Reinforcement learning with deep neural networks

Unit 5 Applications of Deep Learning

Deep learning for image classification and object detection, Natural language processing and sentiment analysis with deep learning, Deep learning in recommendation systems and autonomous vehicles

Recommended Books:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
2. "Deep Learning with Python" by Francois Chollet.

Course: Wireless and Mobile Computing

Course Objective: The Wireless and Mobile Computing course aims to provide students with a comprehensive understanding of the principles, technologies, and applications in the field of wireless and mobile computing. Participants will learn about wireless communication fundamentals, network protocols, and mobile device architectures. The course covers topics like cellular networks, Wi-Fi, Bluetooth, and emerging wireless technologies. Participants will explore mobile application development and optimization techniques, including responsive design and app performance considerations.

Course Outcome: By the end of this course, students should be able to:

1. Explain the basics of mobile telecommunication systems
2. Illustrate the generations of telecommunication systems in wireless networks
3. Determine the functionality of MAC, network layer and identify a routing protocol for a given Ad hoc network
4. Explain the functionality of Transport and Application layers

Course Content:

Unit 1 Existing Wireless Systems

Introduction, Global System for Mobile Communications (GSM), Personal Communications Services (PCS), International Mobile Telecommunications 2000 (IMT-2000). Wireless local area networks. Wireless local loops.

Unit 2 Wireless and Mobile Computing

Overview of the history, evolution, and compatibility of wireless standards; the special problems of wireless and mobile computing.

Unit 3 Mobile Communication Systems

Introduction, mobile Internet protocol; mobile aware adaptation; extending the client-server model to accommodate mobility; mobile data access; the software packages to support mobile and wireless computing; Mobile/Cellular System Infrastructure, Registration, Handoff Parameters and Underlying Support. Roaming Support Using System Backbone. The role of middleware

Unit 4 Satellite Systems

Introduction, Types of Satellite Systems, Characteristics of Satellite Systems, Satellite System Infrastructures, Call Setup, Global Positioning System.

Unit 5 Recent Advances

Introduction, Ultra-Wideband Technology, Multimedia Services Requirements. Mobility Management for Integrated Systems; Multicast in Wireless Networks; MANET Route Maintenance/Repair; Design Issues in Sensor Networks; Bluetooth Networks; Threats and Security Issues.

Recommended Books:

1. Introduction to Wireless and Mobile Systems, Dharma P. Agrawal.
2. Internetworking with TCP/IP Vol.1: Principles, Protocols, and Architecture, 4/e, Comer, Douglas E., Prentice Hall.

Course: Blockchain Technology

Course Objective: The objective of this course is to provide students with a comprehensive understanding of blockchain technology and its applications. The course aims to develop students' skills in designing, implementing, and evaluating blockchain solutions for various industries.

Course Outcome: By the end of this course, students should be able to:

1. Understand the underlying concepts and principles of blockchain technology.
2. Design and develop blockchain applications using appropriate frameworks and tools.
3. Analyze and evaluate the security and privacy aspects of blockchain systems.
4. Apply smart contracts and decentralized applications (DApps) in blockchain development.
5. Explore the potential use cases and implications of blockchain technology in different industries.

Course Content:

Unit 1 Introduction to Blockchain Technology

Overview of blockchain concepts, decentralized systems, and consensus algorithms, Blockchain types: public, private, and consortium, Cryptography fundamentals for blockchain

Unit 2 Blockchain Development Platforms and Tools

Introduction to blockchain development frameworks (e.g., Ethereum, Hyperledger), Setting up the blockchain development environment, Smart contracts and programming languages (e.g., Solidity)

Unit 3 Blockchain Security and Privacy

Blockchain security challenges and attacks, Cryptographic techniques for securing blockchain transactions, Privacy and anonymity considerations in blockchain systems

Unit 4 Smart Contracts and Decentralized Applications (DApps)

Smart contract development and testing, Interacting with smart contracts using web interfaces and APIs, Building and deploying decentralized applications (DApps)

Unit 5 Blockchain Applications and Industry Use Cases

Blockchain applications in finance, supply chain, healthcare, and other domains, Regulatory and legal considerations for blockchain adoption, Evaluating the potential impact of blockchain on various industries

Recommended Books:

1. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" by Imran Bashir.
2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher.