

Dr. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY

(Established as State Technical University in the State of Maharashtra)

Under Maharashtra Act No. XXIX of 2014

Po. Lonere, Dist. Raigad, Pin 402 103, Maharashtra.

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Proposed Syllabus Structure

for

***Second Year B. Tech in Computer Science and
Engineering-Artificial Intelligence***

with effective from July 2020 – 21

Semester – III (Second Year)
Proposed Scheme with effective from July 2021

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
1		Engineering Mathematics - III	3	1	-	20	20	60	100	4
2		Discrete Mathematics	3	1	-	20	20	60	100	4
3		Data Structures	3	1	-	20	20	60	100	4
4		Concepts in Artificial Intelligence	3	1	-	20	20	60	100	4
5		Elective –I (a) Object-oriented Programming in C++ (b) Object-Oriented Programming in Java	3	1	-	20	20	60	100	4
6		Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
7		Seminar I*	1	-	4	60	-	40	100	2
8		Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
TOTAL			16	5	8	220	100	380		24

***Note: Seminar I will cover website development essentials along with CSS, JavaScripts, and basics of PHP**

University Authorities are requested to add appropriate course codes for each of the subject

Semester – IV (Second Year)
Proposed Scheme with effective from January 2022

Sr. No.	Course Code	Course Title	Weekly Teaching hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
1		Computer Organization and Architecture	2	1	-	20	20	60	100	3
2		Operating Systems	3	1	-	20	20	60	100	4
3		Basic Human Rights	3	-	-	20	20	60	100	3
4		Probability Theory & Random Processes	3	1	-	20	20	60	100	4
5		Digital Logic Design & Microprocessor	3	1		20	20	60	100	4
4		Operating Systems & Probability Theory Lab	-	-	4	60	-	40	100	2
5		Seminar - II **	2	-	4	60	-	40	100	4
6		Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit to be evaluated in V Sem.
TOTAL			16	4	8	220	100	380		24

****Note: Seminar II will cover Data Visualization and Analysis along with Python Programming**

University Authorities are requested to add appropriate course codes for each of the subject

Engineering Mathematics-III

[UNIT 1] Vectors in \mathbb{R}^n , \mathbb{C}^n and Spatial Vectors

[7 Hours]

Introduction, Vectors in \mathbb{R}^n , Vector Addition and Scalar Multiplication, Dot (Inner) Product, Located Vectors, Hyperplanes, Lines, Curves in \mathbb{R}^n , Vectors in \mathbb{R}^3 (Spatial Vectors), *ijk* Notation, Complex Numbers, Vectors in \mathbb{C}^n .

[UNIT 2] Algebra of Matrices

[7 Hours]

Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.

[UNIT 3] System of Linear Equations

[7 Hours]

Introduction, Basic Definitions, Solutions, Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations, Elementary Matrices, LU Decomposition. Applications: Linear Programming, Fourier series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography.

[UNIT 4] Determinants

[7 Hours]

Determinants: Introduction, Determinants of Orders 1 and 2, Determinants of Order 3, Permutations, Determinants of Arbitrary Order, Properties of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical Adjoint, Applications to Linear Equations, Cramer's Rule, Submatrices, Minors, Principal Minors, Block Matrices and Determinants, Determinants and Volume, Determinant of a Linear Operator, Multilinearity and Determinants.

[UNIT 5] Diagonalization: Eigenvalues, Eigenvectors and Applications.

[7 Hours]

Diagonalization Introduction, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem, Diagonalization, Eigenvalues and Eigenvectors, Computing Eigenvalues and Eigenvectors, Diagonalizing Matrices, Diagonalizing Real Symmetric Matrices and Quadratic Forms, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices. Applications: Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.

Text Book:

1. Linear Algebra, Seymour Lipschutz, Schaums outlines, 4th Edition, McGraw-Hill Publication.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley-Cambridge Press.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.

Discrete Mathematics

[UNIT 1] Fundamental Structures and Basic Logic

[7 Hours]

Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic, Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

[UNIT 2] Functions and Relations

[7 Hours]

Subjective, Injective, Bijective, and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity, and equivalence relations.

Combinatorics: Counting, Recurrence relations, generating functions.

[UNIT 3] Graph

[7 Hours]

Basic terminology, Multigraphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graphs, Isomorphic graphs, Planar graphs, Connectivity, Matching Coloring.

[UNIT 4] Trees

[7 Hours]

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimum spanning tree.

[UNIT 5] Algebraic Structures and Morphism

[7 Hours]

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010. Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
5. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

Data Structures

[UNIT 1] Introduction

[7 Hours]

Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. Arrays and Hash Tables Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

[UNIT 2] Stacks and Queues

[7 Hours]

Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

[UNIT 3] Linked list

[7 Hours]

Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

[UNIT 4] Trees and Graphs

[7 Hours]

Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.

[UNIT 5] Searching and Sorting

[7 Hours]

Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations– insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Text Book:

1. Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition, 2013

Reference Books:

1. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
2. Y. Langsam, M. Augenstein, A. Tanenbaum, Data Structure using C and C++, Prentice Hall India Learning Private Limited, 2nd edition, 1998.
3. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition, 2008.
4. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.
5. Venkatesan & Rose, Data Structures, Wiley Publication, 1st Edition, 2015.
6. Goodrich & Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition, 2011.
7. R. G. Dromey, How to Solve it by Computer, 2nd Impression, Pearson Education.
8. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition, 1999.

Concepts in Artificial Intelligence

[UNIT 1] Fundamental of Artificial Intelligence

[8 Hours]

Introduction, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation

[UNIT 2] Uninformed Search Strategies

[8 Hours]

Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems

[UNIT 3] Informed Search Strategies

[8 Hours]

Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence

[UNIT 4] Knowledge Representation

[8 Hours]

Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. Basics of PROLOG: Representation, Structure, Backtracking. Expert System: Case study of Expert System in PROLOG

[UNIT 5] Conceptual Graphs & Conceptual Dependencies

[8 Hours]

Network-based representation and reasoning, Semantic networks, Conceptual Graphs, frames. Description logic (DL), concept language, reasoning using DL. Conceptual dependencies (CD), scripts, reasoning using CD. Introduction to natural language processing.

Text Books

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.
3. Introduction to AI & Expert System: Dan W. Patterson, PHI.

Reference Books

1. Ivan Bratko : "Prolog Programming For Artificial Intelligence" , 2nd Edition Addison Wesley, 1440.
2. Eugene, Charniak, Drew McDermott: "Introduction to Artificial Intelligence.", Addison Wesley
3. Carl Townsend, —Introduction to turbo Prolog, Paperback
4. Nilsson: —Principles of Artificial Intelligence, Morgan Kaufmann.

Elective –I (A)
Object Oriented Programming in C++

[Unit 1] Introduction to Object Oriented Programming and Objects and Classes [7 Hours]

Need of object-oriented programming, The object-oriented approach, Characteristics of object oriented languages, class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

[Unit 2] Operator Overloading, Inheritance and Polymorphism [7 Hours]

Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

[Unit 3] Polymorphism [7 Hours]

Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

[Unit 4] Streams and Files [7 Hours]

Streams, Stream output and input, Stream manipulators, Files, and streams, Creating, Reading, Updating sequential and random files.

[Unit 5] Templates, Exception Handling and STL [7 Hours]

Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.

Reference Books:

1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001.
2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.
3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1st Editio, 2008
4. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
5. P. J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.
6. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
7. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.

Elective –I (B)

Object Oriented Programming in JAVA

[Unit 1] Introduction to Java Applications

[7 Hours]

Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Introduction to Classes and Objects: Introduction, Classes, Objects, Methods and Instance Variables, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, *set* Methods and *get* Methods, Primitive Types vs. Reference type double Types, Initializing Objects with Constructors, floating point numbers.

[Unit 2] Control Statements

[7 Hours]

Control structures *if* single-selection statement, *if... else* double-selection statement, *while* repetition statement, *do... while* repetition statement, *switch* multi-selection statement, *break*, and *continue* statements, logical operators. Methods: Introduction, Program modules in Java, *static* methods, *static* Fields, and *Class Math*, declaring methods with multiple parameters, scope of declaration, method overloading and Java API packages.

[Unit 3] Arrays

[7 Hours]

Arrays, declaring and creating arrays in java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

[Unit 4] Inheritance and Polymorphism in Java

[7 Hours]

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, object class. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples and Interfaces.

[Unit 5] Exception Handling & Multithreaded Programming

[7 Hours]

Exception handling fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, Java Thread Model, Main Thread, Creating a Thread, Creating Multiple Threads, Using *isAlive()* and *join()*, Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads

Text Book:

1. Paul Deitel and Harvey Detail, *Java: How to Program*, Pearson's Publication, 9th Edition.

Reference Books:

1. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016. Doug Lowe, *Java All-in-One For Dummies*, Wiley Publication, 4th Edition, 2014.
2. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Publication, 9th Edition.
3. Patrick Niemeyer, Daniel Leuck, *Learning Java*, O'Reilly Media, 4th Edition, 2013.
4. —JavaScript: The Good Parts, Douglas Crockford, O'Reilly, ISBN: 9782744055973.
—Microsoft® .NET: Architecting Applications for the Enterprise, Microsoft Press; 1st edition, ISBN: 978-0735626096

Data Structure Laboratory

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks and a program to convert a given infix expression to postfix form using stacks.
3. Write a program to implement a circular queue using arrays.
4. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
5. Write programs to implement a Single linked list.
6. Write programs to implement Double linked list.
7. Write a program to create a binary search tree (BST).
8. Write a program to implement hashing with Open addressing methods.
9. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort
10. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.
- 11. Design and develop a mini application using the studied data structures.**

Elective –I

Object Oriented Programming Lab

(a) Object Oriented Programming in C++

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on Classes: String and Math.
3. Programs on Inheritance and Polymorphism.
4. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
5. Programs on Interfaces block initializers, final Modifier, as well as static and dynamic binding.
6. Programs on file handling and stream manipulation.
7. Programs on Dynamic Polymorphism and programs on Dynamic Memory Management.
8. Programs on Exception Handling.
9. Programs on generic programming using templates.
10. Programs on STL-containers and iterators
11. Design and develop a mini-application based on the concepts studied.

(b) Object Oriented Programming in JAVA

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate following Function concepts
 - i) Function overloading
 - ii) Constructors of all types
 - iii) Default parameters, returning by reference
4. Programs on Inheritance and Polymorphism.
5. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
6. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
7. Programs on the creation of simple packages, interfaces, and Exception Handling.
8. Programs on Java script client-side scripting and Validations using object functions.
9. Programs on Java script Operators, Comparisons, Statements, Loops, Events, Objects.
10. Programs on Java script JS document object model, Popovers, Windows.
11. Design and develop a mini application based on the studied contents.

Seminar – I

One hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

[Unit 1]

Web Site development Essentials: Overview of Web Design Concepts, Web Project Management Fundamentals, Web Site Development Process, HTML and the Evolution of Markup languages, HTML basic tags, Web Page Layout and Elements, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

[Unit 2]

Cascading Style Sheets: Cascading Style Sheets for Web page design, Creating CSS rules, Format Text with CSS, Use of CSS Selectors, Embed Style Sheets, and Attach External Style Sheets. Using CSS with Tables: Insert and Styling Tables, Import Table Data, Style Tables with CSS, Sort Data in Table.

[Unit 3]

Introduction to JavaScript, Variables, Basic in JavaScript — Numbers and operators, Handling text — Strings in JavaScript, Useful string methods, Arrays, Troubleshooting JavaScript; Programming fundamentals: If...Else Statements, Else...If Statements, For Loops, While Loops, Breaking Out Of Loops, Switch Statements, Functions; JavaScript Events, Selecting HTML elements using get Element ById().

[Unit 4]

PHP: Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Handling Html Form with PHP: Capturing Form Data, Dealing with Multi-value filed, redirecting a form after submission, PHP Session.

[Unit 5]

JQuery: Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples
AJAX: Introduction to AJAX, PHP with AJAX Introduction to RDBMS: Connection with MySQL Database, Performing basic database operation (DML)(Insert, Delete, Update, Select)

Suggestive List of Experiments:

1. Design an html form for displaying information using interactive css including images, tables.
2. Create a webpage with HTML describing your department with following specification:
 - a. Change the background color of the page. At the bottom create a link to take user to the top of the page.
 - b. Insert an image and create a link such that clicking on image takes user to other page.
 - c. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.
3. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
4. Develop and demonstrate a HTML file that includes JavaScript script that uses functions for the following problems:
 - a. Input Parameter: A string
Output: Length of the String
 - b. Parameter: A number

Output: The number with its digits in the reverse order

c. Input: A starting and ending number

Output: find all the prime numbers between starting and ending number.

5. Write a PHP program to display a digital clock which displays the current time of the server.
6. Write a PHP program to implement sign-In and Sign-out functionality.
7. Write a PHP program to keep track of the number of visitors visiting the Web page and to display this count of visitors, with proper headings.
8. Write a PHP code to implement AJAX functionality.
9. Write a PHP program to perform search operation on the student records using AJAX.
10. Write a PHP program to sort the student records which are stored in the database using ascending/descending order.
11. Design and implement a mini application on the basis of studied contents

Text Book:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, Ajax, PHP and jQuery, 2ed (English, Paperback, DT Editorial Services).

Reference Books:

1. Robin Nixon, Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5 Paperback by Orielly Pub.
2. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, 2nd Edition, 2012.

Guidelines for Seminar:

1. Each candidate shall deliver a seminar as per the Scheme of Teaching and Examination for a minimum 35 minutes including questions and answers.
2. Students can choose/propose any topic for web application development.
3. Students can use HTML, CSS, Java Script, AJAX, PHP, or any other front-end tool for web application development.
4. Applications developed must be demonstrated on desktop/laptop as a web-based application in the seminar.
5. A seminar report must be submitted at the end of semester on the basis of Website/Application developed and technology used

Computer Architecture and Organization

[UNIT 1] Introduction

[7 Hours]

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function

[Unit 2] Instruction Sets

[7 Hours]

Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

[Unit 3] Computer Arithmetic

[7 Hours]

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

[Unit 4] Memory Organization

[7 Hours]

Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

[Unit 5] Control Unit and Input / Output Organization

[7 Hours]

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming. **Input/output Organization:** External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface. Instruction pipelining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Book:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Operating Systems

[Unit 1]

[7 Hours]

Introduction and Operating system structures: Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.

[Unit 2]

[7 Hours]

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.

[Unit 3]

[7 Hours]

Process Synchronization: The critical-section problem, Critical regions, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

[Unit 4]

[7 Hours]

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

[Unit 5]

[7 Hours]

File Management: File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.

Reference Books:

1. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
2. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
3. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
4. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
5. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

Basic Human Rights

[Unit 1]

[6 Hours]

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution, Rights of citizen, Rights of working and exploited people.

[Unit 2]

[6 Hours]

Fundamental rights and economic programmed, Society, religion, culture, and their inter relationship, Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

[Unit 3]

[6 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged, State, Individual liberty, Freedom and democracy, NGOs and human rights in India: - Land, Water, Forest issues.

[Unit 4]

[6 Hours]

Human rights in Indian constitution and law:- i) The constitution of India: Preamble ii) Fundamental rights iii) Directive principles of state policy vi) Fundamental duties v) Some other provisions.

[Unit 5]

[6 Hours]

Indian Intermediary guidelines and social media ethics code 2021: Due diligence by intermediaries; Due diligence by intermediaries; Code of Ethics for Digital Media Publishers; Grievance redressal; Blocking of content in case of emergency; A case study based on the above contents.

Text Book:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

Reference books:

1. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India

Probability Theory & Random Processes

[Unit 1] Probability Theory

[7 Hours]

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

[Unit 2] Random Variable and Mathematical Expectation

[8 Hours]

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Joint and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

[Unit 3] Correlation

[7 Hours]

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.

[Unit 4] Linear Regression Analysis

[8 Hours]

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y , Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

[Unit 5] Estimation and Hypothesis

[7 Hours]

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Book:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revised and Enlarged Edition, 2016.

Reference Books:

1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. EhsanesSaleh, An Introduction to Probability And Statistics, Wiley

Publication, 2nd Edition, 2001.

8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition, Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics for engineers & scientists, 9th edition, Prentice Hall.

Digital Logic Design & Microprocessor

[Unit1] Introduction

[7 Hours]

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, Number Systems: binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.

[Unit 2] Combinational Digital Circuits

[7 Hours]

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions, Don't care conditions, Multiplexer, De-Multiplexer / Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, parity checker / generator.

[Unit 3] Sequential circuits and systems

[7 Hours]

1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, asynchronous sequential counters, applications of counters.

[Unit 4] Fundamentals of Microprocessors

[7 Hours]

Fundamentals of Microprocessor, Comparison of 8-bit, (8085) 16-bit (8086), and 32-bit microprocessors (80386), The 8086 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

[Unit 5] 8086 Instruction Set and Programming

[7 Hours]

Memory Interfacing, I/O Interfacing, Direct Memory Access (DMA), Interrupts in 8086, 8086 Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs, Assemblers and compilers, Programming and debugging tools.

Text Book:

1. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

Reference Books:

1. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
2. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
3. Douglas Hall, Microprocessors and Interfacing, McGraw-Hill Publication, Revised 2nd Edition,

Operating Systems Laboratory

List of Experiments:

1. Hands on Unix Commands and Shell Script programming using the commands grep, awk, and sed.
2. Shell programming for file handling
3. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
4. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
5. Study pthreads and implement the following: Write a program which shows the performance. Concurrent programming; use of threads and processes, system calls (fork and v-fork)
6. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
7. Implementation of Producer-Consumer problem, Banker's algorithm.
8. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
9. Kernel reconfiguration, device drivers and systems administration of different operating systems.
10. Writing utilities and OS performance tuning.
11. Design and develop a mini application based on the studied contents.

Probability Theory lab in using Python

List of Experiments:

1. Write a program on conditional probability using python.
2. Write a program using python for following statement.

Assume a fixed probability of flipping heads and simulate a flipping a heads (H) or Tails (T) by using choice function in the NumPi module to randomly select one of these two outcomes. Display simulated flips; accumulate the number of heads and the ratio of heads to total flips as a probability derives from the frequency of occurrences.

3. Write a python program on simulating a rolling of six sided dice for following statement

We must randomly select one of six options (1,2,3,4,5, 6), which by default we assume all have equal probabilities (equal to $1/6$). At the end, we accumulate the number of rolls that results in an ace (or 1), and display the ratio of this sum two the total number of rolls as a probability derive from the frequency of occurrence.

4. Implement normal probability distribution using python.
5. Implement binomial distribution using python.
6. Implement poisons probability distribution using python.
7. Write a python program for Pearson correlation test between two variables.
8. Study of simple linear regression model using python.
9. Implement python code for following statement
“You have ten ages and you are checking whether average age is 30 or not?”
10. T-Test-performing hypothesis testing with python.
11. Study of different types of correlation and implement any one using python programming.

Seminar II

Two hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

[Unit 1] [2 Hours]

An informal introduction to programming, algorithms, and data structures, downloading and installing Python, run a simple program on Python interpreter.

[Unit 2] [2 Hours]

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.

[Unit 3] [2 Hours]

Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.

[Unit 4] [2 Hours]

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

[Unit 5] [4 Hours]

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data. Graphs in Python. Data Visualization and Data Analysis using Python.

List of Experiments:

1. Program to calculate area of triangle, rectangle, circle
2. Program to find the union and intersection of two lists.
3. Program to remove the i-th occurrence of the given word in a list where words repeat.
4. Program to count the occurrences of a word or a substring in a given string sentence.
5. Program to map two lists into a dictionary.
6. Program to count the frequency of words appearing in a string using a dictionary.
7. Program to create a dictionary with key as first character and value as words starting with that character.
8. Program to find the length of a list using recursion.
9. compute the diameter, circumference, and volume of a sphere using class
10. Program to read a file and capitalize the first letter of every word in the file.
11. Design and develop a mini application based on the studied contents

Text Book:

1. Michael Urban and Joel Murach, Murach's Python Programming, Murach's Publication, 2016.

Reference Books:

1. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
2. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.

3. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
4. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
5. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
6. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

Guidelines for Seminar II:

1. Each candidate shall deliver a seminar as per the Scheme of Teaching and Examination for a minimum 35 minutes including questions and answers.
2. Students can choose/propose any topic for python programming, data visualization, and data analysis.
3. Students can use different python libraries for data visualization and analysis application development.
4. Applications developed must be demonstrated on desktop/laptop as a web based application or mobile application in the seminar.
5. A seminar report must be submitted at the end of semester on the basis of application developed and technology used.