EVALUATION SCHEME AND SYLLABI

For

B. E. 2nd Year

Common to All Branches

(CSE, AI & ML, Data Science)

Effective from the Session: 2026-27

08.06.2026

Semester III

SN	Subject Code	Course Title	Type	Category	L	T	P	CT	TA	CT+TA (SW)	(TE/PE) (ESE)	SW+ESE Total Marks	Credits
1	BAS303	Mathematics (PDE, Probability and Statistics)	T	BS	3	1	0	15	10	25	75	100	4
2	BAS301	Technical Communication	T	HS	2	1	0	15	10	25	75	100	3
3	BCS301	Data Structure	T	PC	3	1	0	15	10	25	75	100	4
4	BCS302	Computer Organization and Architecture	T	PC	3	1	0	15	10	25	75	100	4
5	BCS303	Discrete Structures	T	PC	2	1	0	15	10	25	75	100	2
6	BCS351	Data Structure Lab	P	PC	0	0	2	-	25	25	75	100	1
7	BCS352	Computer Organization and Architecture Lab	P	PC	0	0	2	-	25	25	75	100	1
8	BCS353	Web Designing Workshop	P	PC	0	0	2	-	25	25	75	100	0
9	BCC301	Python Programming	T	VA	2	0	0	15	10	25	75	100	2
10	BCC351	Internship Assessment / Mini Project*	P	VA	0	0	0	-	100	100	-	100	1
Total					15	5	6					1000	22

Abbreviations

- **BS** = Basic Science
- **HS** = Humanities & Social Science
- **PC** = Professional Core
- **VA** = Value Added Course
- **L** = Lecture
- **T** = Tutorial
- **P** = Practical
- **CT** = Class Test
- **TA** = Teacher Assessment
- **SW** = Sessional Work
- **ESE** = End Semester Examination
- **TE/PE** = Theory/Practical Examination

Semester IV

SN	Subject Code	Course Title	Type	Category	L	T	P	CT	TA/SW	Internal Total	End Semester Examination (ESE)	Total Marks	Credits
1	BAS403	Food Science and Nutrition	T	BS	3	1	0	15	10	25	75	100	4
2	BVE401	Universal Human Value and Professional Ethics	T	VA	2	1	0	15	10	25	75	100	3
3	BCS401	Operating System	T	PC	3	1	0	15	10	25	75	100	4
4	BCS402	Theory of Computation	T	PC	3	1	0	15	10	25	75	100	4
5	BCS403	Object Oriented Programming with Java	T	PC	2	1	0	15	10	25	75	100	3
6	BCS451	Operating System Lab	P	PC	0	0	2		0	25	75	100	1
7	BCS452	Object Oriented Programming with Java Lab	P	PC	0	0	2		0	25	75	100	1
8	BCS453	Cyber Security Workshop	P	PC	0	0	2		0	25	75	100	0
9	BCC401	Cyber Security and Cyber Laws	P	VA	2	0	0	15	10	25	75	100	2
10	BVE451 / BVE452	Sports and Yoga-II / NSS-II	P	VA	0	0	3			100		100	0
Total					15	5	9					1000	22

SYLLABUS

BCS301: DATA STRUCTURE

Unit I: Introduction and Linear Data Structures

Introduction to Data Structures, basic terminology, elementary data organization, and built-in data types in C. Concepts of algorithms, efficiency of algorithms, time and space complexity, asymptotic notations, and Abstract Data Types (ADT).
Arrays: Definition and types of arrays, single-dimensional and multidimensional arrays. Array representation in Row Major Order and Column Major Order. Derivation of index formulas for 1-D, 2-D, 3-D, and n-D arrays. Applications of arrays. Sparse matrices and their representations.
Linked Lists: Array and pointer implementation of singly linked lists, doubly linked lists, and circular linked lists. Operations on linked lists including insertion, deletion, and traversal. Polynomial representation and operations such as addition, subtraction, and multiplication of single-variable and two-variable polynomials.

Unit II: Stacks and Queues

Stacks: Abstract Data Type (ADT), primitive operations such as Push and Pop, array and linked implementations of stacks in C. Applications of stacks including prefix and postfix expressions, and evaluation of postfix expressions.
Recursion and Iteration: Principles of recursion, tail recursion, removal of recursion, and problem-solving using recursion and iteration. Applications include binary search, Fibonacci series, and Tower of Hanoi. Comparison and trade-offs between iteration and recursion.
Queues: Queue operations including create, insert (enqueue), delete (dequeue), full and empty conditions. Circular queues, array and linked implementations of queues in C, dequeues (double-ended queues), and priority queues.

Unit III: Searching and Sorting

Searching Techniques: Concept of searching, sequential search, indexed sequential search, and binary search.
Hashing: Concept of hashing and collision resolution techniques.
Sorting Techniques: Insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort, and radix sort.

Unit IV: Trees

Introduction to trees and basic tree terminology. Binary trees and their representations using arrays and linked lists. Binary Search Trees (BST), strictly binary trees, complete binary trees, and extended binary trees.
Tree Traversal: Inorder, preorder, and postorder traversals. Construction of binary trees from given traversals.
Operations on Binary Search Trees: Insertion, deletion, searching, and modification of data.
Threaded Binary Trees: Concepts and traversal techniques.
Applications of Trees: Huffman coding using binary trees. Introduction and basic operations of AVL trees, B-trees, and binary heaps.

Unit V: Graphs

Introduction to graph terminology and graph representations using adjacency matrices and adjacency lists.
Graph Traversal Techniques: Depth First Search (DFS) and Breadth First Search (BFS). Connected components and spanning trees.
Minimum Cost Spanning Trees: Prim's algorithm and Kruskal's algorithm.
Shortest Path and Closure Algorithms: Transitive closure using Warshall's algorithm and shortest path finding using Dijkstra's algorithm.

Text Books / Suggested References

1. Salaria, R.S., **Data Structures**, Khanna Book Publishing, 2019.
2. Kruse, Robert L., Tondo, C.L., and Leung, Bruce, **Data Structures and Program Design in C**, Pearson Education, 2007.
3. Patel, R.B., **Expert Data Structures with C (3rd Edition)**, Khanna Book Publishing, 2020.
4. Patel, R.B., **Expert Data Structures with C++ (2nd Edition)**, Khanna Book Publishing, 2020.
5. Langsam, Augenstein, and Tanenbaum, **Data Structures Using C & C++**, Pearson Education, 1989.
6. Horowitz, Ellis and Sahni, Sartaj, **Fundamentals of Data Structures**, Computer Science Press, 2011.
7. Trembley, J.P. and Sorensen, P.G., **An Introduction to Data Structures with Applications**, Tata McGraw-Hill, 2004.

BCS302: COMPUTER ORGANIZATION AND ARCHITECTURE

Unit I: Introduction to Computer Organization

Introduction to the functional units of a digital computer system and their interconnections. Concepts of buses, bus architecture, types of buses, and bus arbitration. Register transfer, bus transfer, and memory transfer operations.
Processor Organization: General register organization, stack organization, and various addressing modes used in computer systems.

Unit II: Arithmetic and Logic Unit (ALU)

Design and operation of Arithmetic and Logic Units (ALU). Carry look-ahead adders for fast arithmetic operations.
Multiplication Techniques: Signed operand multiplication, Booth's algorithm, and array multipliers.
Division and Logic Operations: Binary division methods and logical operations.
Floating Point Arithmetic: Floating-point representation, arithmetic operations, ALU design considerations, and IEEE standards for floating-point numbers.

Unit III: Control Unit

Instruction types, instruction formats, instruction cycles, and sub-cycles such as fetch, decode, and execute. Micro-operations and execution of complete instructions.
Program Control: Concepts of Reduced Instruction Set Computer (RISC) architecture and instruction pipelining.
Control Unit Design: Hardwired control and microprogrammed control units. Microprogram sequencing and concepts of horizontal and vertical microprogramming.

Unit IV: Memory Organization

Basic concepts of memory systems and memory hierarchy. Semiconductor RAM memories and memory organization techniques including 2D and 2½D memory organization.
Read-Only Memories (ROM): Types and applications of ROM.
Cache Memory: Concepts, design issues, performance considerations, address mapping techniques, and replacement policies.
Auxiliary Memory: Magnetic disks, magnetic tapes, and optical disks.
Virtual Memory: Concepts, organization, and implementation techniques.

Unit V: Input/Output Organization

Peripheral devices and I/O interfaces. I/O ports and interrupt mechanisms.
Interrupts: Interrupt hardware, types of interrupts, and exceptions.
Modes of Data Transfer:

- Programmed I/O
- Interrupt-Initiated I/O
- Direct Memory Access (DMA)

I/O Channels and Processors: Concepts and applications.
Serial Communication: Synchronous and asynchronous communication, and standard communication interfaces.

Text Books

1. M. Morris Mano, **Computer System Architecture.**
2. Carl Hamacher, Zvonko Vranesic, and Safwat Zaky, **Computer Organization**, McGraw-Hill, Fifth Edition, Reprint 2012.
3. John P. Hayes, **Computer Architecture and Organization**, Tata McGraw-Hill, Third Edition, 1998.

Reference Books

4. William Stallings, **Computer Organization and Architecture: Designing for Performance**, Pearson Education, Seventh Edition, 2006.
5. Behrooz Parhami, **Computer Architecture**, Oxford University Press, Eighth Impression, 2011.
6. David A. Patterson and John L. Hennessy, **Computer Architecture: A Quantitative Approach**, Elsevier India Private Limited, Fifth Edition, 2012.
7. Andrew S. Tanenbaum, **Structured Computer Organization**, PHI Publications.

BCS303: DISCRETE STRUCTURES

Unit I: Set Theory, Relations, and Lattices

Introduction to Set Theory and operations on sets. Relations: Definition, types of relations, operations on relations, properties of relations, composite relations, equality of relations, recursive definition of relations, and ordering relations.
Partially Ordered Sets (POSET) and Lattices: Hasse diagrams, partially ordered sets, definition and properties of lattices including bounded lattices, complemented lattices, distributive lattices, modular lattices, and complete lattices.

Unit II: Functions and Boolean Algebra

Functions: Definition, classification and types of functions, operations on functions, and growth of functions.
Boolean Algebra: Introduction, axioms and theorems of Boolean algebra, algebraic manipulation of Boolean expressions, simplification of Boolean functions, and Karnaugh Maps (K-Maps).

Unit III: Theory of Logic

Propositional Logic: Propositions, truth tables, tautologies, satisfiability, contradictions, algebra of propositions, and theory of inference.
Predicate Logic: First-order predicates, well-formed formulas (WFF), quantifiers, and inference theory of predicate logic.

Unit IV: Algebraic Structures

Introduction to algebraic structures. Definition and properties of groups, subgroups, order of groups and subgroups, cyclic groups, cosets, and Lagrange's theorem.
Advanced Group Theory: Normal subgroups, permutation groups, symmetric groups, and group homomorphisms.
Rings and Fields: Definition and elementary properties of rings and fields.

Unit V: Graph Theory and Combinatorics

Graph Theory: Definition and terminology of graphs, graph representations, multigraphs, bipartite graphs, planar graphs, graph isomorphism and homeomorphism, Euler paths and circuits, Hamiltonian paths and circuits, and graph coloring.
Combinatorics: Introduction to combinatorics, counting techniques, and the Pigeonhole Principle.

Text Books

1. Koshy, **Discrete Structures**, Elsevier Publications, 2008.
2. Kenneth H. Rosen, **Discrete Mathematics and Its Applications (6th Edition)**, McGraw-Hill, 2006.
3. B. Kolman, R.C. Busby, and S.C. Ross, **Discrete Mathematical Structures (5th Edition)**, Prentice Hall, 2004.
4. E.R. Scheinerman, **Mathematics: A Discrete Introduction**, Brooks/Cole, 2000.
5. R.P. Grimaldi, **Discrete and Combinatorial Mathematics (5th Edition)**, Addison-Wesley.

Reference Books

6. Seymour Lipschutz, **Discrete Mathematics**, McGraw-Hill.
7. J.P. Tremblay and R. Manohar, **Discrete Mathematical Structures with Applications to Computer Science**, McGraw-Hill.
8. Narsingh Deo, **Graph Theory with Applications to Engineering and Computer Science**, PHI.
9. V. Krishnamurthy, **Combinatorics: Theory and Applications**, East-West Press Pvt. Ltd., New Delhi.

BAS303: MATHEMATICS (PDE, PROBABILITY AND STATISTICS)

Unit I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non-Linear Partial Differential Equations of First Order, Lagrange's Method for solving Linear Partial Differential Equations, Charpit's Method for solving Non-Linear Partial Differential Equations, Solution of Linear Partial Differential Equations of Higher Order with Constant Coefficients, Equations Reducible to Linear Partial Differential Equations with Constant Coefficients.

Unit II: Applications of Partial Differential Equations and Fourier Transform

Method of Separation of Variables, Solution of One-Dimensional Heat Equation and Wave Equation, Two-Dimensional Heat Equation (Laplace Equation only) and its Applications, Complex Fourier Transform, Fourier Sine Transform, Fourier Cosine Transform, Inverse Fourier Transform, Convolution Theorem, Applications of Fourier Transform in solving Partial Differential Equations.

Unit III: Statistical Techniques – I

Overview of Measures of Central Tendency, Moments, Skewness, Kurtosis, Curve Fitting, Method of Least Squares, Fitting of Straight Lines, Fitting of Second-Degree Parabola and Exponential Curves, Correlation and Rank Correlation, Regression Analysis: Regression Lines of (y) on (x) and (x) on (y).

Unit IV: Statistical Techniques – II

Overview of Probability, Random Variables (Discrete and Continuous), Probability Mass Function and Probability Density Function, Expectation and Variance, Discrete and Continuous Probability Distributions: Binomial, Poisson, and Normal Distributions.

Unit V: Statistical Techniques – III

Introduction to Sampling Theory, Hypothesis, Null Hypothesis, Alternative Hypothesis, Testing of Hypothesis, Level of Significance, Confidence Limits, Tests of Significance for Difference of Means, t-test, Z-test, and Chi-square Test, Statistical Quality Control (SQC), Control Charts, Control Charts for Variables ((X) and (R) Charts), and Control Charts for Attributes ((p), (np), and (c) Charts).

Text Book

1. Higher Engineering Mathematics — B. S. Grewal, Khanna Publishers, New Delhi.

Reference Books

1. Advanced Engineering Mathematics — Peter V. O'Neil, Cengage Learning, 2017.
2. Higher Engineering Mathematics — B. V. Ramana, McGraw-Hill Education, 2017.
3. Introductory Methods of Numerical Analysis — S. S. Sastry, Prentice Hall of India.
4. Advanced Engineering Mathematics — Erwin Kreyszig, John Wiley Publications, 1999.
5. Numerical Methods — R. K. Jain and S. R. K. Iyengar, New Age International (P) Limited.
6. An Introduction to Numerical Methods and Analysis — James F. Epperson, Wiley.

BAS301: TECHNICAL COMMUNICATION

Unit I: Fundamentals of Communication and Voice Dynamics

Role and Purpose of Communication, Types and Flow of Communication, Barriers to Effective Communication, 7 C's of Communication, Code and Content, Stimulus and Response, Vowel Sounds, Consonant Sounds, Tone: Rising and Falling Tone.

Unit II: Communication Skills for Career Building

CV and Résumé Writing, Interview Skills, Group Discussion, Effective Profiling, Communication and Networking: Building Relationships, Writing the Statement of Purpose (SOP) for Admission to Higher Studies, Seminar and Conference Paper Writing, Expert Technical Lecture: Writing and Presentation.

Unit III: Communication Skills for Presentation: Writing, Designing, and Speaking

Thesis and Project Report Writing, Technical Proposal Writing, How to Pitch an Idea: Process, Preparation, and Structure, Elements of Speech Delivery: Passion, Poise, and Illustrations.

Unit IV: Communication and Leadership Development

Leadership Communication, Communication and Social Competence: Context, Feelings, Intentions, and Behaviors, Providing and Receiving Feedback, Difference between Tact and Intelligence, Emotional Intelligence: Trust through Communication, Thinking Skills: Meaning and Types.

Unit V: Digital Communication and Personality Development

Content Creation for Social Media: Emails, Webinars, Podcasts, and Blogs, Effective and Ethical Use of Social Media through Text and Technique, Speech and Personality, Personality Analysis: Types of Personality, Concepts of Personality by Maslow, Freud, Vivekananda, Jung Typology, and Personality Assessment.

Prescribed Books

1. Technical Communication: Principles and Practices — Meenakshi Raman and Sangeeta Sharma, Oxford University Press, New Delhi, 2018.
2. Personality Development and Soft Skills — Barun K. Mitra, Oxford University Press, New Delhi, 2012.
3. Technical Communication — Pearson Education.
4. Soft Skills and Employability — Sabina Pillai and Agna Fernandez, Cambridge University Press, 2018.
5. Practical Communication: Process and Practice — L. U. B. Pandey, A.I.T.B.S. Publications India Ltd., Krishan Nagar, Delhi, 2014.

BCC301:PYTHON PROGRAMMING

Unit I: Introduction to Python

Introduction to Python, Python Variables, Basic Operators in Python, Understanding Python Blocks, Python Data Types, Declaring and Using Numeric Data Types such as int, float, etc.

Unit II: Python Program Flow Control

Conditional Blocks: if, else, and elif Statements, Simple for Loops in Python, for Loops using range(), Strings, Lists, and Dictionaries, Use of while Loops in Python, Loop Manipulation using pass, continue, break, and else, Programming using Python Conditional and Loop Constructs.

Unit III: Python Complex Data Types and Functions

Using String Data Type and String Operations, Defining Lists and List Slicing, Use of Tuple Data Type, String, List, and Dictionary Manipulations, Building Blocks of Python Programs, String Manipulation Methods, List Manipulation Techniques, Dictionary Manipulation, Programming using In-built Functions of Strings, Lists, and Dictionaries, Python Functions, Organizing Python Code using Functions.

Unit IV: Python File Operations

Reading Files, Writing Files in Python, Understanding File Read Functions: read(), readline(), and readlines(), Understanding File Write Functions: write() and writelines(), Manipulating File Pointers using seek(), Programming using File Operations.

Unit V: Python Packages and GUI Programming

Simple Programs using Built-in Functions of Python Packages such as matplotlib, numpy, and pandas, Introduction to GUI Programming, Introduction to Tkinter, Tkinter and Python Programming, Tk Widgets, Tkinter Examples, Python Programming using IDEs.

Text Books

1. Core Python Applications Programming — Wesley J. Chun, Pearson Education, 2016.
2. Fundamentals of Python: First Programs with MindTap — Cengage Learning Publications.
3. Introduction to Computer Science Using Python — Charles Dierbach, Wiley, 2015.
4. Introduction to Computing and Problem Solving with Python — Jeeva Jose and P. Sojan Lal, Khanna Publishers, New Delhi, 2016.
5. How to Think Like a Computer Scientist: Learning with Python — Allen Downey et al., John Wiley, 2015.
6. Learning Python — Mark Lutz, O'Reilly Publications, 2013, ISBN: 978-1449355739.
7. Python Programming: An Introduction to Computer Science — John Zelle, Course Technology Cengage Learning Publications, 2013, ISBN: 978-1590282410.
8. Python Programming for Absolute Beginners — Michael Dawson, Course Technology Cengage Learning Publications, 2013, ISBN: 978-1435455009.
9. Python Cookbook — David Beazley and Brian K. Jones, O'Reilly Publications, 2013, ISBN: 978-1449340377.

BCS351- Data Structure Lab

List of Experiments (Indicative & not limited to)

1. **Implementing Sorting Techniques:** Bubble Sort, Insertion Sort, Selection Sort, Shell , Sort, Radix Sort, Quick sort
2. **Implementing Searching and Hashing Techniques:** Linear search, Binary search, Methods for Hashing: Modulo Division, Digit Extraction, Fold shift, Fold Boundary, Linear Probe for Collision Resolution. Direct and Subtraction hashing
3. **Implementing Stacks:** Array implementation, Linked List implementation, Evaluation of postfix expression and balancing of parenthesis, Conversion of infix notation to postfix notation
4. **Implementing Queue:** Linked List implementation of ordinary queue, Array implementation of circular queue, Linked List implementation of priority queue, Double ended queue
5. **Implementing Linked List:** Singly Linked Lists, Circular Linked List, Doubly Linked Lists: Insert, Display, Delete, Search, Count, Reverse (SLL), Polynomial, Addition, Comparative study of arrays and linked list
6. **Implementing Trees:** Binary search tree: Create, Recursive traversal: preorder, post order, in order, Search Largest, Node, Smallest Node, Count number of nodes, Heap: Min Heap, Max Heap: reheap Up, reheap Down, Delete, Expression Tree, Heapsort
7. **Implementing Graphs**: Represent a graph using the Adjacency Matrix, BFS, Find the minimum spanning tree (using any method Kruskal's Algorithm or Prim's Algorithm) Self Learning Topics: Shortest Path Algorithm

BCS352- Computer Organization Lab

List of Experiments (Indicative & not limited to)

1. Implementing HALF ADDER, FULL ADDER using basic logic gates
2. Implementing Binary -to -Gray, Gray -to -Binary code conversions.
3. Implementing 3-8 line DECODER.
4. Implementing 4x1 and 8x1 MULTIPLEXERS.
5. Verify the excitation tables of various FLIP-FLOPS.
6. Design of an 8-bit Input/ Output system with four 8-bit Internal Registers.
7. Design of an 8-bit ARITHMETIC LOGIC UNIT.
8. Design the data path of a computer from its register transfer language description.
9. Design the control unit of a computer using either hardwiring or microprogramming based on its register transfer language description.
10. Implement a simple instruction set computer with a control unit and a data path.

FOURTH SEMESTER

BCS401: OPERATING SYSTEM

Unit I: Introduction

Introduction to Operating Systems and their functions. Classification of Operating Systems including Batch Systems, Interactive Systems, Time-Sharing Systems, Real-Time Systems, Multiprocessor Systems, Multiuser Systems, Multiprocess Systems, and Multithreaded Systems.
Operating System Structure: Layered Structure, System Components, Operating System Services, Reentrant Kernels, Monolithic Systems, and Microkernel Systems.

Unit II: Concurrent Processes

Process Concept and Principles of Concurrency. Producer-Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's Solution, Peterson's Solution, Semaphores, and Test-and-Set Operation.
Classical Problems in Concurrency: Dining Philosopher Problem and Sleeping Barber Problem.
Inter-Process Communication (IPC) Models and Schemes, and Process Generation.

Unit III: CPU Scheduling and Deadlocks

CPU Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Schedulers, Process Control Block (PCB), Process Address Space, and Process Identification Information.
Threads and their Management, Scheduling Algorithms, and Multiprocessor Scheduling.
Deadlocks: System Model, Deadlock Characterization, Deadlock Prevention, Avoidance, Detection, and Recovery from Deadlocks.

Unit IV: Memory Management

Basic Bare Machine, Resident Monitor, Multiprogramming with Fixed Partitions, Multiprogramming with Variable Partitions, and Protection Schemes.
Paging, Segmentation, Paged Segmentation, Virtual Memory Concepts, Demand Paging, and Performance of Demand Paging.
Page Replacement Algorithms, Thrashing, Cache Memory Organization, and Locality of Reference.

Unit V: I/O Management, Disk Scheduling, and File Systems

I/O Devices and I/O Subsystems, I/O Buffering, Disk Storage, Disk Scheduling, and RAID.
File System: File Concept, File Organization, Access Mechanisms, File Directories, and File Sharing.
File System Implementation Issues, File System Protection, and Security.

Text Books

1. **Operating System Concepts** – Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, Wiley.
2. **Operating Systems** – Sibsankar Halder and Alex A. Aravind, Pearson Education.
3. **An Introduction to Operating Systems** – Harvey M. Deitel, Pearson Education.
4. **Operating Systems: A Concept-Based Approach (2nd Edition)** – D. M. Dhamdhere, Tata McGraw-Hill.
5. **Operating Systems: Internals and Design Principles (6th Edition)** – William Stallings, Pearson Education.

BCS402: THEORY OF AUTOMATA

Unit I: Basic Concepts and Automata Theory

Introduction to Theory of Computation, Automata, Computability and Complexity. Concepts of alphabet, symbol, string, and formal languages. Deterministic Finite Automata (DFA): definition, representation, string acceptance, and language recognition. Non-Deterministic Finite Automata (NFA), equivalence of DFA and NFA, NFA with ε-transitions, and equivalence of NFA with and without ε-transitions. Finite automata with output, including Moore and Mealy machines, their equivalence, and minimization of finite automata.

Unit II: Regular Expressions and Languages

Regular expressions and transition graphs. Kleene's Theorem. Relationship between finite automata and regular expressions. Arden's Theorem and algebraic methods using Arden's Theorem. Regular and non-regular languages, closure properties of regular languages, pigeonhole principle, pumping lemma and its applications. Decidability, decision properties, and finite automata for regular languages.

Unit III: Regular and Non-Regular Grammars

Context-Free Grammar (CFG): definition, derivations, languages, derivation trees, and ambiguity. Regular grammars including right-linear and left-linear grammars. Conversion of finite automata into CFG and regular grammar into finite automata. Simplification of CFG. Normal forms such as Chomsky Normal Form (CNF) and Greibach Normal Form (GNF). Chomsky hierarchy and programming problems based on CFG properties.

Unit IV: Pushdown Automata and Context-Free Languages

Non-Deterministic Pushdown Automata (NPDA): definition, moves, and language acceptance. Deterministic Pushdown Automata (DPDA) and Deterministic Context-Free Languages (DCFL). Pushdown automata for context-free languages and context-free grammars for pushdown automata. Two-stack pushdown automata. Pumping lemma for CFL, closure properties of CFL, decision problems of CFL, and programming problems based on CFL properties.

Unit V: Turing Machines and Recursive Function Theory

Basic Turing Machine model, representation, and language acceptance. Techniques for Turing machine construction and modifications of Turing machines. Turing machine as a computer for integer functions. Universal Turing Machine, Linear Bounded Automata, and Church's Thesis. Recursive and recursively enumerable languages, Halting Problem, Post Correspondence Problem (PCP), and introduction to Recursive Function Theory.

Text Books

1. Introduction to Automata Theory, Languages and Computation – J. E. Hopcroft, R. Motwani, and J. D. Ullman, Pearson Education Asia.
2. Introduction to Languages and the Theory of Computation – John Martin, Tata McGraw Hill.
Elements of the Theory of Computation – C. Papadimitriou and C. L. Lewis, PHI.
Mathematical Foundation of Computer Science – Y. N. Singh, New Age International.

BCS403: OBJECT ORIENTED PROGRAMMING WITH JAVA

Unit I: Introduction to Java and Object-Oriented Programming

Introduction to Java, history of Java, JVM, JRE, Java environment, Java source file structure, and compilation process. Fundamental programming concepts including classes, constructors, methods, access specifiers, static and final members, comments, data types, variables, operators, control flow statements, arrays, and strings.

Object-Oriented Programming concepts such as classes, objects, inheritance, superclass, subclass, method overriding, method overloading, encapsulation, polymorphism, abstraction, interfaces, and abstract classes.

Packages in Java, package definition, CLASSPATH settings, creating JAR files for library packages, import and static import statements, and package naming conventions.

Unit II: Exception Handling, I/O, and Multithreading

Exception handling concepts including exceptions and errors, types of exceptions, control flow in exception handling, JVM reaction to exceptions, and the use of try, catch, finally, throw, and throws. In-built and user-defined exceptions, checked and unchecked exceptions.

Input/Output basics including byte streams, character streams, and file reading and writing in Java.

Multithreading concepts such as threads, thread life cycle, thread creation, thread priorities, thread synchronization, and inter-thread communication.

Unit III: Modern Java Features

Functional interfaces, lambda expressions, method references, Stream API, default methods, static methods, Base64 encoding and decoding, forEach method, try-with-resources, type annotations, repeating annotations, and Java Module System.

Advanced Java features including diamond syntax with anonymous inner classes, local variable type inference, switch expressions, yield keyword, text blocks, records, and sealed classes.

Unit IV: Java Collections Framework

Introduction to collections and the Java Collections Framework. Collection hierarchy, Iterator interface, Collection interface, and List interface.

Implementation classes including ArrayList, LinkedList, Vector, Stack, Queue, HashSet, LinkedHashSet, TreeSet, HashMap, LinkedHashMap, TreeMap, and Hashtable.

Sorting techniques, Comparable and Comparator interfaces, and Properties class in Java.

Unit V: Spring Framework and Spring Boot

Introduction to Spring Framework, dependency injection, inversion of control (IoC), aspect-oriented programming (AOP), bean scopes (singleton, prototype, request, session, application, and web socket), autowiring, annotations, life-cycle callbacks, and bean configuration styles.

Introduction to Spring Boot, build systems, project structure, runners, logging, and development of RESTful web services. Topics include Rest Controller, Request Mapping, Request Body, Path Variable, Request Parameter, and implementation of GET, POST, PUT, and DELETE APIs. Building web applications using Spring Boot.

Recommended Books:

Herbert Schildt, *Java: The Complete Reference*, McGraw-Hill Education.
Craig Walls, *Spring Boot in Action*, Manning Publications.
Steven Holzner, *Java Black Book*, Dreamtech Press.
E. Balagurusamy, *Programming in Java*, McGraw-Hill Education.
Herbert Schildt, *Java: A Beginner's Guide*, Oracle Press.
Greg L. Turnquist, *Learning Spring Boot 2.0 (Second Edition)*, Packt Publishing.
A.J. Henley Jr. and Dave Wolf, *Introduction to Java Spring Boot: Learning by Coding*, Independently Published.

BCC401: CYBER SECURITY AND CYBER LAWS

Unit I: Introduction to Cyber Crime

Introduction to cybercrime, origin of the term cybercrime, and information security. Study of cybercriminals and their characteristics, classification of cybercrimes, global perspective of cybercrime, and survival strategies for internet users. Understanding cyber offenses, attack planning by criminals, social engineering, cyber stalking, cybercafés and cybercrime, botnets, and common attack vectors.

Unit II: Cyber Crime in Mobile and Wireless Devices

Introduction to mobile and wireless devices, growth of mobile technologies, and current mobility trends. Credit card frauds in mobile and wireless environments, security challenges of mobile devices, registry settings, authentication service security, attacks on mobile and cell phones, security implications for organizations, and organizational policies and measures for secure mobile computing.

Unit III: Tools and Methods Used in Cybercrime

Overview of cybercrime tools and techniques including proxy servers, anonymizers, phishing, password cracking, keyloggers, spyware, viruses, worms, Trojan horses, backdoors, steganography, DoS and DDoS attacks, SQL injection, buffer overflow attacks, and attacks on wireless networks. Introduction to phishing, identity theft, and preventive measures against such attacks.

Unit IV: Understanding Computer Forensics

Introduction to computer forensics and digital forensic science. Need for computer forensics, cyber forensics, digital evidence, forensic analysis of e-mails, digital forensics life cycle, chain of custody, network forensics, and investigation approaches in computer forensics. Security and privacy threats in social networking sites and challenges faced in computer forensic investigations.

Unit V: Introduction to Security Policies and Cyber Laws

Need for information security policies and introduction to Indian cyber laws. Objectives and scope of the Digital Personal Data Protection Act, 2023. Intellectual property issues and overview of intellectual property-related legislation in India, including patents, copyrights, and trademarks.

Text Books

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives — Sunit Belapure and Nina Godbole, Wiley India Pvt. Ltd., 2013, ISBN: 978-8126521791.
2. Cyber Security and Cyber Laws — Cengage Learning Publications, 1st Edition.
3. Introduction to Information Security and Cyber Laws — Surya Prakash Tripathi, Ritendra Goyal and Praveen Kumar Shukla, Dreamtech Press, 2015, ISBN: 9789351194736.
4. Cyber Security and Data Privacy — Krishan Kumar Goyal, Amit Garg and Saurabh Singhal, HP Hamilton Limited Publications, ISBN: 9781913936020.
5. Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions — Thomas J. Mowbray, John Wiley & Sons, 2014, ISBN: 9781118849651.
6. Cyber Security Essentials — James Graham, Ryan Olson and Rick Howard, CRC Press, 2010.
7. Anti-Hacker Tool Kit — Mike Shema, McGraw-Hill Publications, Indian Edition.

BCS451- Operating System Lab

List of Experiments (Indicative & not limited to)

1. Study of hardware and software requirements of different operating systems (UNIX, LINUX, WINDOWS XP, WINDOWS7/8/10/11
2. Execute various UNIX system calls for
   i. Process management
   ii. File management
   iii. Input/output Systems calls
3. Implement CPU Scheduling Policies:
   i. SJF
   ii. Priority
   iii. FCFS
   iv. Multi-level Queue
4. Implement file storage allocation technique:
   a. Contiguous (using array)
   b. Linked –list (using linked-list)
   c. Indirect allocation (indexing)
5. Implementation of contiguous allocation techniques:
   I. Worst-Fit
   ii. Best- Fit
   iii. First- Fit
6. Calculation of external and internal fragmentation
   I. Free space list of blocks from system
   ii. List process file from the system
7. Implementation of compaction for the continually changing memory layout and calculate total movement of data.
8. Implementation of resource allocation graph RAG)
9. Implementation of Banker's algorithm
10. Conversion of resource allocation graph (RAG) to wait for graph (WFG) for each type of method used for storing graph.
11. Implement the solution for Bounded Buffer (producer-consumer) problem using inter process communication techniques-Semaphores
12. Implement the solutions for Readers-Writers problem using inter process communication technique -Semaphore

BCS452- Object Oriented Programming with Java

List of Experiments (Indicative & not limited to)

1. Use Java compiler and eclipse platform to write and execute java program.
2. Creating simple java programs using command line arguments
3. Understand OOP concepts and basics of Java programming.
4. Create Java programs using inheritance and polymorphism.
5. Implement error-handling techniques using exception handling and multithreading.
6. Create java program with the use of java packages.
7. Construct java program using Java I/O package.
8. Create industry-oriented application using Spring Framework.
9. Test RESTful web services using Spring Boot.
10. Test Frontend web application with Spring Boot

BVE401-HUMAN VALUES AND PROFESSIONAL ETHICS

Unit I: Course Introduction – Need, Basic Guidelines, Content, and Process for Value Education

Understanding the Need, Basic Guidelines, Content, and Process for Value Education, Self-Exploration: Meaning, Content, and Process, Natural Acceptance and Experiential Validation as the Mechanism for Self-Exploration, Continuous Happiness and Prosperity: A Study of Basic Human Aspirations, Right Understanding, Relationship, and Physical Facilities as Basic Requirements for Fulfillment of Human Aspirations with Correct Priority, Understanding Happiness and Prosperity Correctly: A Critical Appraisal of the Current Scenario, Methods to Fulfill Human Aspirations through Understanding and Living in Harmony at Various Levels.

Unit II: Understanding Harmony in the Human Being – Harmony in Myself

Understanding the Human Being as a Co-existence of the Sentient 'I' and the Material 'Body', Understanding the Needs of Self ('I') and Body: *Sukh* and *Suvidha*, Understanding the Body as an Instrument of 'I' (*I* being the Doer, Seer, and Enjoyer), Understanding the Characteristics and Activities of 'I' and Harmony in 'I', Understanding the Harmony of 'I' with the Body: *Sanyam* and *Swasthya*, Correct Appraisal of Physical Needs, Meaning of Prosperity in Detail, Programs to Ensure *Sanyam* and *Swasthya*.

Unit III: Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship

Understanding Harmony in the Family as the Basic Unit of Human Interaction, Understanding Values in Human-Human Relationships, Meaning of *Nyaya* and Programs for its Fulfillment to Ensure *Ubhay-Tripti*, Trust (*Vishwas*) and Respect (*Samman*) as Foundational Values of Relationships, Understanding the Meaning of *Vishwas*, Difference between Intention and Competence, Understanding the Meaning of *Samman*, Difference between Respect and Differentiation, Other Salient Values in Relationships, Understanding Harmony in Society (Society as an Extension of Family): *Samadhan*, *Samridhi*, *Abhay*, and *Sah-astitva* as Comprehensive Human Goals, Visualizing a Universal Harmonious Order in Society — Undivided Society (*Akhand Samaj*) and Universal Order (*Sarvabhaum Vyawastha*) from Family to World Family.

Unit IV: Understanding Harmony in Nature and Existence – Whole Existence as Co-existence

Understanding Harmony in Nature, Interconnectedness and Mutual Fulfilment among the Four Orders of Nature, Recyclability and Self-Regulation in Nature, Understanding Existence as Co-existence (*Sah-astitva*) of Mutually Interacting Units in All-Pervasive Space, Holistic Perception of Harmony at all Levels of Existence.

Unit V: Implications of Holistic Understanding of Harmony on Professional Ethics

Natural Acceptance of Human Values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics:

- Ability to Utilize Professional Competence for Augmenting Universal Human Order.
- Ability to Identify the Scope and Characteristics of People-Friendly and Eco-Friendly Production Systems, Technologies, and Management Models.

Case Studies of Holistic Technologies, Management Models, and Production Systems, Strategy for Transition from the Present State to Universal Human Order:

- At the Individual Level: Socially and Ecologically Responsible Engineers, Technologists, and Managers.
- At the Societal Level: Mutually Enriching Institutions and Organizations.

Text Book

1. A Foundation Course in Human Values and Professional Ethics — R. R. Gaur, R. Sangal and G. P. Bagaria, 2009.

Reference Books

1. Energy and Equity — Ivan Illich, The Trinity Press, Worcester and Harper Collins, USA, 1974.
2. Small Is Beautiful: Economics as if People Mattered — E. F. Schumacher, Blond & Briggs, Britain, 1973.
3. How the Other Half Dies — Susan George, Penguin Press, 1976.
4. Limits to Growth — Donella H. Meadows, Universe Books, 1972.
5. Jeevan Vidya Ek Parichay — A. Nagraj, Divya Path Sansthan, Amarkantak, 1998.
6. Science and Humanism — P. L. Dhar and R. R. Gaur, Commonwealth Publishers, 1990.
7. Human Values — A. N. Tripathy, New Age International Publishers, 2003.

8. How to Practice Natural Farming — Subhash Palekar, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati, 2000.
9. Fundamentals of Ethics for Scientists and Engineers — E. G. Seebauer and Robert L. Berry, Oxford University Press, 2000.
10. Engineering Ethics — M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, Prentice Hall of India, Eastern Economy Edition.

BAS 403-FOOD SCIENCE & NUTRITION

Unit I: Introduction to Food Science and Nutrition

Food Science Fundamentals
Introduction to food science, functions of food, food groups, food pyramid, and the chemical constituents of food along with their properties.
Nutrition and Health
Concept of nutrition, relationship between nutrition and good health, malnutrition, causes and effects of malnutrition, and common nutritional deficiency diseases.

Unit II: Human Nutrition and Diet Planning

Energy and Nutrient Utilization
Energy requirements of the human body, determination of individual energy needs, calorific value of foods, digestion process, and utilization of nutrients in the body.
Balanced Diet and Nutritional Requirements
Nutrition during different stages of life, nutritional requirements for various age groups, Recommended Dietary Allowances (RDA), Recommended Dietary Intakes (RDI), and balanced diet planning.

Unit III: Food Processing and Preservation

Food Processing Operations
Concept of food processing and food preservation. Various food processing methods including cooking, roasting, broiling, poaching, stewing, simmering, marinating, blanching, baking, and pasteurization.
Food Preservation Techniques
Principles and methods of food preservation and their applications in the food industry.

Unit IV: Food Quality and Safety

Food Quality Management
Concept of quality, quality attributes of foods, quality control cycle, Total Quality Management (TQM), regulatory bodies, and accreditation bodies.
Food Safety and Security
Food security, food safety, importance of food safety, food-borne illnesses, food adulteration, and Hazard Analysis and Critical Control Point (HACCP).

Unit V: Food Packaging and Food Industry in India

Food Packaging
Food packaging, types of packages, desirable characteristics of food packages, food package labels, label declarations, and packaging guidelines.
Food Processing Sector in India
Food processing industries in India, growth of the food processing sector, opportunities, challenges, present status, and future prospects.

Text Books

1. Norman N. Potter and Joseph H. Hotchkiss, *Food Science*, 5th Edition, CBS Publishers & Distributors Pvt. Ltd., 2007.
2. Shubhangini A. Joshi, *Nutrition and Dietetics*, 4th Edition, Tata McGraw-Hill Publishing Company Ltd., 2017.
3. McWilliams, M., *Food Fundamentals*, 10th Edition, Pearson Education, 2015.
4. B. Srilakshmi, *Food Science*, 7th Edition, New Age International (P) Ltd., New Delhi, 2018.