

**Khandesh Education Society's,  
Pratap College, Amalner (Autonomous)  
Dist. Jalgaon.**



**‘A+’ Grade NAAC Reaccredited  
(CGPA 3.52)  
DST-FIST Assisted College  
UGC Honored “A College with Potential for Excellence”**

**Syllabus for  
Fourth Year B. Sc.  
For the Degree of  
Honors in  
Computer Science  
Under New Education Policy-2020  
(With effect from June 2023)**

**Faculty of Science and Technology  
Fourth Year B. Sc. Programme  
Department of Computer Science**

**Credit Distribution Structure for Three / Four / Year Honors / Honors with research degree programme with multiple entry and exit options**

Level (year)	Sem	Major (Core) Subjects		Minor Subjects (Min)	GE / OE	VSC, SEC	AEC, VEC, IKS (2 credits)	CC, FP, CEP, OJT / Int, RP
		Mandatory	Elective					
Fourth Year B.Sc. Comp. Science	I	THEORETICAL COMPUTER SCIENCE	SOFTWARE ENGINEERING					
		ADVANCED JAVA						
		ADVANCED DATABASE MANAGEMENT SYSTEM						
		LAB ON ADMBS+JAVA						
	II	COMPILER CONSTRUCTION	ADVANCED OPERATING SYSTEM					
		ARTIFICIAL INTELLIGENCE						
		DESIGN & ANALYSIS OF ALGORITHMS						
		LAB ON DAA						

### **PROGRAMME OBJECTIVES (POs):**

- 1) Broadly Educated and Versatile - Able to draw upon foundational knowledge, learn, adapt and successfully bring to bear analytical and computational approaches on changing societal and technological challenges.
- 2) Inspiring and Collaborative - Able to induce and contribute to diverse teams, expertise, and experiences.
- 3) Innovative - Drives scientific and societal advancement through technological innovation and entrepreneurship.
- 4) Engaged - Is and remains engaged with the academics, technical and scientific professional communities

### **PROGRAMME SPECIFIC OUTCOMES (PSOs):**

Program has been designed to prepare graduates for attaining the following program outcomes:

- 1) An ability to apply knowledge of computer science appropriate to the discipline.
- 2) An ability to apply computer science foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- 3) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- 4) Communicate effectively in a variety of professional and research contexts.
- 5) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- 6) Apply computer science theory and software development fundamentals to produce computing-based solutions.
- 7) Acquire and apply new knowledge as needed, using appropriate learning strategies.

**SEM : I**  
**Major Core Subject-I:**  
**THEORETICAL COMPUTER SCIENCE**

Theory: 30 Hours

<p><b>Course Content:</b></p>	<p><b>Unit-1 Grammers and Regular Languages:</b> [L:12, M:15]  Production systems, Right Linear, Left Linear grammer, Context free grammer, Regular expressions : Defination and examples, Regular expressions from DFA, Parikh Mapping, Derivation Trees and Ambiguity.</p> <p><b>Unit-2 Finite Automata</b> [L:15, M:20]  Deterministic and Non deterministic Finite Automata, NFA with E-Moves, Equivalence of Regular Expressions and FA, Pumping Lemma, Applications of Pumping Lemma, Closure Properties of Regular Sets, Myhill-Nerode Theoram, FA with output. Pumping lemma for regular sets, application of pumping lemma, closure properties of regular sets.</p> <p><b>Unit-3 Pushdown Automata:</b> [L:15,M:20]  Normalforms: Chomsky Normal Form, Griebach Normal Form., Equivalence between PDA and CFG, Closure Properties of CFL, Deterministic PDA, Acceptance by empty store and Final State, Simplification of CFG, Elimination of NULL and UNIT Production, Normal Forms CNF and GNF.</p> <p><b>Unit-4 Turing Machine:</b> [L:10, M:15]  Techniques for TM construction : Generalized and restricted versions equivalent to the basic model, Godel numbering, Universal TM, recursive enumerable sets and recursive sets, context sensitive languages and linear bounded automata (LBA.)</p> <p><b>Unit-5 Decidability and Computability:</b> [L:4, M:12]  Post correspondence problem, Rice’s Theoram, decidability of membership, emptiness and equivalence problems of languages, Recursive Functions, Primitive Recursive functions, Primitive Recursive Functions over N</p> <p><b>Unit-7 Complexity measures:</b> [L:4, M:8]  Time and tape complexity measures of Turing machines, Random Access Machines, the classes P and NP, NP completeness, Satisfiability, Cooks Theoram, Regulated L System Grammer Systems.</p>
<p><b>References:</b></p>	<ol style="list-style-type: none"> <li>1. K. Krithivasan and R. Rama, “Introduction to Formal Automata Theory and Computation”, 2009, ISBN: 9788131723562, Pearson Education.</li> <li>2. J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory Languages and Computation”, 2nd Edition, 2001, ISBN: 9780201441246, Pearson Education Asia.</li> <li>3. Bernard M. Moret, “The Theory of Computation”, 2nd Edition, 2008, ISBN: 9788131708705, Pearson Education.</li> </ol>

**SEM I**  
**Major Core Subject-II:**  
**ADVANCED JAVA**  
Theory: 30 Hours

<b>Course Content</b>	<p><b>Unit-1 Java Basics Review</b> [M:15, L:12]  Java streaming ,Networking , Event handling , Multithreading, Byte code Interpretation , Customizing application , Data Structures ,Collection classes.</p> <p><b>Unit-2 Distributed Computing</b> [M:15, L:12]  Custom sockets ,Remote Method Invocation , Object Activation, Object serialization, Distributed garbage collection, RMI - IIOP , CORBA - Interface definition language, JINI overview.</p> <p><b>Unit-3 Java Beans and Swing</b> [M:18, L:12]  Bean concepts ,Events in bean box , Bean customization , Persistence , Application, Deployment using swing , Advanced swing techniques , JAR file handling.</p> <p><b>Unit-4 Java Enterprise Applications</b> [M:17, L:12]  JNI , Servlets ,Life cycle of Servlets, Handling HTTP Request and Response, Java Server Pages, JDBC, Session beans, Entity beans, Programming and deploying enterprise Java Beans, Java transactions</p> <p><b>Unit-5 Related Java Techniques</b> [M:25, L:12]  Java Struts, Java Media Frame work, 3D graphics, Internationalization, Case study, Deploying n-tier application, E- commerce applications.</p>
<b>References</b>	<ol style="list-style-type: none"> <li>1.Paul J. Deitel, Harvey M. Deitel, “Java How to program “,8th Edition, 2010, ISBN: 9780136053064, Pearson Prentice Hall.</li> <li>2.Gary Cornell and Cay S. Horstmann, “Core Java Vol 1 and Vol 2”, 5th Edition, 2001, ISBN: 0130894680, Sun Microsystems Press.</li> <li>3.Stephen Asbury, Scott R. Weiner, “Developing Java Enterprise Applications”,1stEdition, 1999, ISBN: 978-0471327561, Wiley.</li> <li>4.RajkumarBuyya, S. ThamaraiSelvi , Xingchen Chu, “Object Oriented Programmingwith JAVA: : Essentials and Applications” ,2009, ISBN: 9780070678835, TataMcGraw Hill Education.</li> </ol>

**SEM I**  
**Major Core Subject-III:**  
**ADVANCED DATABASE MANAGEMENT SYSTEM**  
Theory: 30 Hours

<b>Course Content</b>	<p><b>Unit-1 Database System Architectures</b> [L:08, M:12]  Centralized and Client-Server Architectures, Server System Architectures, Parallel Systems, Distributed Systems</p> <p><b>Unit-2 Parallel Databases</b> [L:08, M:12]  Introduction, I/O Parallelism, Inter and Intra Query Parallelism, Inter and Intra operation Parallelism</p> <p><b>Unit-3 Distributed Database Concepts</b> [L:08, M:12]  Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control, Distributed Query Processing – Three Tier Client Server Architecture.</p> <p><b>Unit-3 Object and Object Relational Databases</b> [L:12, M:18]  Concepts for Object Databases, Object Identity, Object structure and Type Constructors, Encapsulation of Operations, Methods and Persistence, Type and Class Hierarchies and Inheritance, Complex Objects, Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle</p> <p><b>Unit-4 XML Databases</b> [L:08, M:12]  XML Data Model, XML Documents, DTD and XML Schema, XML Querying, Web Databases – JDBC – Information Retrieval – Data Warehousing – Data Mining</p> <p><b>Unit-5 Mobile Databases</b> [L:08, M:12]  Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols- Mobile Database Recovery Schemes</p> <p><b>Unit-6 Multimedia Database</b> [L:08, M:12]  Multidimensional Data Structures – Image Databases – Text/Document Databases- Video Databases – Audio Databases – Multimedia Database Design.</p>
<b>References:</b>	<ol style="list-style-type: none"> <li>1. AviSilberschatz, Henry F. Korth,S. Sudarshan, “Database System Concept”, 4th Edition,2001, ISBN: 0072283637, McGraw-Hill publications.</li> <li>2. RamezElmasri, ShamkantNavathe, “Fundamental of Database Systems”,5thEdition, 2009,ISBN: 9780321369574,Pearson Education.</li> <li>3. Alexis Leon, Mathews Leon, “Database Systems concept”, 2002, ISBN: 9788125911654, Leon Vikas.</li> </ol>

**SEM I**  
**Major Core Subject-IV:**  
**LAB ON ADBMS**

**Course  
Content**

1. Write down Stored Procedure for inserting , updating values in the table
2. Write down stored procedure to accept input values as a parameter and update values of the tables
3. Write down DML trigger to raise the error while inserting duplicate value in the table
4. Write down DML trigger to raise the error violating Check Constraints
5. Write down DML trigger to raise the error when user deletes more than 5 records from table
6. Create index and measure the performance of query on the table
7. Compare results before and after indexing by considering any sample table
8. Write down stored procedure for selecting first five records and copy that five records in another table
9. Write down function which prints higher salaried person from table by inputing his empid and name
10. Write down function which selects part name(substring, like surname,firstname or middle name and copy that part in another table's column)

**SEM I**  
**ELECTIVE:**  
**SOFTWARE ENGINEERING**

Theory: 30 Hours

<b>Course Content</b>	<p><b>Unit – 1 Introduction to Software Engineering</b> [L:8, M:10]  The nature of software, Defining software, Software Application Domain, Legacy Software, Software Engineering, Software Process</p> <p><b>Unit -2 Software Process Models</b> [L:8, M:10]  Incremental Process Model, Concurrent Process Model, Specialized Process Model</p> <p><b>Unit -3 Requirement Specifications</b> [L:8, M:15]  Requirements Engineering, Establishing the ground work, Eliciting Requirements, Developing Use cases, Building the requirements model, validating requirements.</p> <p><b>Unit – 4 Design Concepts</b> [L:12, M:20]  Design Process, Concepts, Design Models, Architectural Design- Software architecture, Architectural Design, User Interface Design – User Interface Analysis and Design, Pattern based Design – Design Pattern</p> <p><b>Unit- 5 Testing</b> [L:8, M:10]  Levels of testing – Functional, Structural, Test Plan, Test case specification, Types of testing – Unit testing, Integration Testing, Function Testing, System testing, Performance testing, Accepting testing.</p> <p><b>Unit- 6 Quality Management</b> [L:8, M:15]  What is quality? , Software quality- Gravin’s quality dimension, McCall’s quality factor, ISO 9126 quality factors, Targeted quality factor, Review Technique- Formal Technical Review</p> <p><b>Unit – 7 Software Configuration Management (SCM) and Project Scheduling</b> [L:8, M:10]  Software Configuration Items, SCM Repository, SCM Process, Scheduling Timeline charts, tracking the schedule</p>
<b>References</b>	<ol style="list-style-type: none"> <li>1. Roger. S. Pressman , “A Practitioner’s Approach”, 7th Edition, 2010, ISBN: 9780071267823, McGraw Hill International Publication.</li> <li>2. K. K. Agrawal, Yogesh Singh, “Software Engineering”,3rdEdition, 2008, ISBN:9788122423600, New age International Publishers.</li> <li>3. RajibMall , “Fundamentals of Software Engineering”, 4th Edition, 2014, ISBN: 9788120348981, Prentice-Hall of India Publication</li> </ol>



# **SEMESTER II**

**SEM II**  
**Major Subject: I**  
**COMPILER CONSTRUCTION**  
**Theory: 30 Hrs.**

**Unit-1 Introduction to Compilers**

[M:10, L:8]

The structure of a compiler, Phases of Compilation: the Analysis – Synthesis Model. Applications of Compiler, Compiler Construction Tools.

**Unit-2 Lexical Analysis**

[M:15, L:12]

A simple approach to the design of lexical analyzers, Role of lexical analyzer, tokens, patterns, lexeme, lexical errors, Specification of tokens, Recognition of tokens, lexical analyzer generator LEX, Regular expressions, Finite automata, From regular expressions to finite automata, Minimizing the number of states of a DFA.

**Unit-3 Syntax Analysis**

[M:25, L:14]

Context-free grammars, Derivations and Parse trees, Ambiguous grammar, Role of parser, types of Parsers: Top down Parsing, Problems in top down parsing, recursive parsing, problems in recursive parsing, predictive parsing, error recovery in predictive parsing.(LL(1)), Bottom –up parsing, Shift reduce parsing, Actions in Shift reduce parser, Operator-precedence parsing, its advantages and disadvantages, error recovery in operator precedence parser, LR parsers: Simple LR, LR (1), LALR parser.

**Unit-4 Intermediate Code generation**

[M:10, L:8]

Need of Intermediate code generation, three address code, Quadruples, triples, indirect triples and blocks

**Unit 5 Code optimization**

[M:15, L:10]

Need of code optimization, classification of code optimization techniques, and optimization within basic blocks: Folding, Redundant operation elimination. Within loop: Strength reduction, Dead code elimination, Moving operation within block, out of block.

**Unit 6 Symbol Table Organization**

[M:15, L:8]

Methods of organizing symbol table: Unsorted, sorted symbol table, Binary Search, hashing technique, its advantages and disadvantages, Collision resolution techniques: Rehashing, Chaining.

**References:**

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compiler Principle, Techniques and Tools”, 2nd Edition illustrated, ISBN: 9781292024349, Pearson Addison Wesley.
2. William A. Barret, John D. Couch, “Compiler Construction Theory and Practice”, Computer Science Series, 1979, ISBN: 978-0574213358, Asian Student Edition.
3. Dhamdhare D. M. , “Compiler Construction Principle and Practice”, 2002, ISBN: 9780333904060, McMillan India.
4. David Gries, “Compiler Construction for Digital Computers”, 1st Edition, 1971, ISBN: 9780471327769, Wiley. 5. David Galles, “Modern Compiler Design”, 2nd Edition , 2009, ISBN: 9788131709412, Pearson Education.

**SEM II**  
**Major Subject: II**  
**ARTIFICIAL INTELLIGENCE**

Theory: 30 Hrs.

**Unit-1 : Introduction to Artificial Intelligence**

**[M: 06, L:4]**

What is Machine Intelligence? The AI Problems, What is an AI Technique, Criteria for Success, AI Task domains.

**Unit-2 : Problems, Problem Spaces, and Search**

**[M:10, L:6]**

Defining the Problem as a State Space Search, Production systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs, Uninformed Search Techniques: DFS and BFS.

**Unit-3 : Heuristic Search Techniques**

**[M:10, L:5]**

Generate-and- Test, Hill Climbing, Best-First Search, A\* Search, AO\* Search

**Unit-4 : Knowledge Representation**

**[M:10, L: 6]**

Knowledge Representation Issues, Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, The Frame Problem.

**Unit-5 : Using Predicate Logic**

**[M:15, L:12]**

Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution, Natural Deduction.

**Unit-6 : Slot and Filler Structures.**

**[M:10, L:8]**

Weak Structures- Semantic Networks. Frames Strong Structures- Conceptual Dependency Representations , Scripts.

**Unit-7 : Learning**

**[M:06, L: 5]**

What is learning?, Rote Learning, Learning by taking advice ,Learning in problem solving, Learning from examples, Explanation based learning

**Unit-8 : Fuzzy logic**

**[M: 10, L: 6]**

Fuzzy Sets, Operations on Fuzzy Sets,Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning,Fuzzy Inference Systems, Fuzzy Expert Systems,Fuzzy Decision Making.

**Unit-9 : Neural networks**

**[M: 13, L: 8]**

Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Unsupervised Learning.

**References:**

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", 2nd Edition, 1991, ISBN: 9780071008945, Tata McGrawHill.
2. Stuart Jonathan Russell, Peter Norvig, "Artificial Intelligence – A modern approach", illustrated, 2010, ISBN:9780136042594, Prentice Hall.

**SEM II**  
**Major Subject: II**  
**DESIGN AND ANALYSIS OF ALGORITHMS**

Theory: 30 Hrs.

**Unit - 1 Introduction**

**[M: 15, L: 14]**

Algorithm definition, Analysis of Algorithms, Principles of Algorithm, Some stylistic issues, Euclid's` algorithm, Recursion - Removal of Recursion (GCD, Factorial), Asymptotic complexity, Heaps (Insert, Adjust), Finding Maximum and Minimum

**Unit - 2 Divide and Conquer**

**[M: 15, L: 8]**

Introduction, Control Abstraction for Divide and Conquer, Binary Search, Sorting(Merge, Quick), Matrix Multiplication

**Unit- 3 Greedy Algorithms**

**[M: 15, L: 12]**

Introduction, Control Abstraction for Greedy Algorithms, Single source shortest path, Minimum cost spanning tree (Kruskal, Prims), Fractional knapsack, Huffman Coding

**Unit- 4 Dynamic Programming**

**[M: 15, L: 14]**

Introduction, Control Abstraction for Dynamic Programming, All pair shortest path, Knapsack (0/1) ,Matrix chain multiplication , Longest common subsequence, DFS and BFS

**Unit - 5 Backtracking**

**[M: 15, L: 6]**

GeneralMethod,8-Queen`problem, Sum of subset problem, Graph coloring problem, Hamiltonian cycle

**Unit - 6 Problem Classifications**

**[M: 15, L: 6]**

Nondeterministic Algorithm, The class of P, NP, NP-hard and NP-Complete problem, Significance of cook`s theorem.

**References:**

1. Ellis Horowitz, SatrajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", 2010, ISBN: 8175152575, Galgothia publications.
2. AnanyLevitin, "Introduction to the design and analysis of Algorithms",2003, ISBN:9788178089843, Pearson Education,
3. Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Edition, 2008, ISBN: 8177585959, Pearson Education..
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein , "Introduction to Algorithms",3rd Edition, 2010, ISBN:9788120340077, Prentice Hall of India.
5. Dieter Jungnickel, "Graph,Network and Algorithms",2nd Edition, 2005, ISBN:3540219056, Springer.

**SEM II**  
**Major Subject: II**  
**LAB ON DAA**

**Design & Analysis of Algorithms**

1. Write a program to implement removal of recursion for
  - i) Finding maximum from array
  - ii) Binomial coefficient  $B(n,m) = B(n-1, m-1) + B(n-1, m)$ ,  $B(n,n) = B(n,0) = 1$
  - iii) Searching element from array
2. Write a program for creating max./min. heap using
  - i) INSERT
  - ii) ADJUST/HEAPIFY
3. Write a program to find minimum and maximum from a given array.
4. Write a program for searching element from given array using binary search for  $n=1000, 2000, 3000$  find exact time of execution.
5. Write a program for sorting given array in ascending/descending order with  $n=1000, 2000, 3000$  find exact time of execution using
  - i) Heap sort
  - ii) Merge sort
  - iii) Quick sort
6. Write a program for matrix multiplication using Strassen's matrix multiplication.
7. Write a program to find solution of Knapsack instant.
8. Write a program to find minimum spanning tree using prim's/kruskal's algorithm.
9. Write a program to find shortest path using single source shortest path.
10. Write a program to find shortest path using all pair path.

**SEM II**  
**ELECTIVE:**  
**ADVANCED OPERATING SYSTEM**

Theory: 30 Hours

**Unit-1: Overview of UNIX Operating System and Shell Programming: [L:10, M:20]**

Architecture of UNIX/LINUX Operating System, Introduction to Kernal, Unix Commands, Introduction to shell programming and Unix commands, Introduction Shell Programming, Types of Shell, Shell Commands, Environment Variables.

**Unit-2 File Subsystem and Directory I/O : [L:20, M:30]**

Nodes, structure of regular file, Inode, Super block, Allocation of Disks Blocks, assignment to a new file, Allocation of disk blocks. System calls for File system:

Open – Read – Write – Adjusting the position of file I/O lseek , Close, Pipes, Dup, Creat, Stat, Fstat, Link and Unlink File, Mounting and unmounting file, creation Changing directory, root, ownership of new files and Directories, mkdir, Rmdir, Reading Directories, Chdir Etc.

**Unit -3 Processes and Signal Handling : [L:10, M:10]**

Process states and transitions, Process Creation, The context of a process, Saving the context of a process, Termination of Process, Signal Concepts, Signal Functions, Signal Management, Sending Signal, Blocking Signals.

**Unit -4 Memory Management: [L:10, M:20]**

Memory Management Policies: Swapping – Demand paging, Driver Interface – Disk Drivers – Process Address Space, Allocating Dynamic Memory.

**Unit-5 Protection and Security: [L:10, M:10]**

Illustration of Security Model of UNIX and other Operating Systems, Examples of attack

**References:**

1. Maurice J. Bach, “The Design of the Unix Operating System”, ISBN : 9780132017992, Prentice Hall.
2. B. Goodheart, J. Cox, “The Magic Garden Explained”, 1994, ISBN: 9780130981387, Prentice Hall of India.
3. S. J. Leffler, M.K. McKusick, M. J. Karels and J. S. Quarterman., “The Design and Implementation of the 4.3 BSD Unix Operating System”, 1st Edition, 1996, ISBN: 9780132317924, Addison-Wesley Professional.
4. J. Hart, “Windows System Programming”, 4th Edition, 2008, ISBN: 9780321658272, Pearson Education.
5. A. Robbins, “Linux Programming by Example: The Fundamentals”, 2nd Edition, 2008, ISBN: 9788131704196, Pearson Education.