



AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

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NAAC "A+" Accredited Institute

Cherukupally (Village), Near Tagarapuvalasa Bridge, Vizianagaram (Dist.), A.P, Pin-531162.

www.aietta.ac.in, principal@aietta.ac

Department of Computer Science and Engineering

Program: B.Tech Computer Science and Engineering

Regulation: R19

Course Outcomes

No. of course: 62

I-I	Course Code: C101	Course Name: Communicative English
CO1	Understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and specific pieces of information	
CO2	Ask and answer general questions on familiar topics and introduce oneself/others.	
CO3	Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information	
CO4	Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs.	
CO5	Form sentences using proper grammatical structures and correct word forms	
I-I	Course Code: C102	Course Name: -Mathematics – I
CO1	Utilize mean value theorems to real life problems.	
CO2	Solve the differential equations related to various engineering fields.	
CO3	Solve linear differential equations of higher order related to engineering applications	
CO4	Familiarize with functions of several variables which is useful in optimization.	
CO5	Apply double integration techniques in evaluating areas bounded by region and learn calculus tools in higher dimensions.	
I-I	Course Code: C103	Course Name: - Applied Chemistry
CO1	Outline the properties, preparation, and applications of polymers, plastics, elastomers, and composite materials.	
CO2	Explain the construction of electrochemical cells/batteries and categorize mechanisms/methods of corrosion control.	
CO3	Understand the preparation and importance of non-elemental semiconductors, nanomaterials, liquid crystals, and superconductors	
CO4	Obtain knowledge of computational chemistry and understand the working principles of artificial molecular machines	
CO5	Understand principles of spectroscopic techniques and explain non-conventional energy sources like photovoltaic cells.	
I-I	Course Code: C104	Course Name: - Fundamentals of computer science



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CO1	Illustrate the concept of input and output devices of computers and recognize basic computer programming terminology.
CO2	Demonstrate techniques for writing algorithms, flowcharts, pseudo code, and understanding programming language tools.
CO3	Recognize computer networks, topologies, OSI models, and summarize fundamental concepts of operating systems.
CO4	Summarize database architectures, data models, query processing, and system development processes.
CO5	Recite advanced computer technologies including cloud computing, grid computing, peer-to-peer systems, and wireless networks.
I-I	Course Code: C105 Course Name: - Engineering Drawing
CO1	Construct regular polygons, engineering curves (ellipse, parabola, hyperbola), cycloids, and use various drawing scales.
CO2	Visualize and draw orthographic projections of points and straight lines inclined to reference planes.
CO3	Visualize and draw orthographic projections of regular 2D planes inclined to reference planes
CO4	Draw orthographic projections of 3D solids (prisms, pyramids, cones, cylinders) in various inclined positions.
CO5	Convert 3D isometric views to 2D orthographic views and vice versa using manual and Auto CAD methods.
I-I	Course Code: C106 Course Name English Lab
CO1	Demonstrate correct pronunciation, phonetic transcription, and appropriate use of stress, rhythm, and intonation in spoken English.
CO2	Comprehend spoken and written texts by identifying context, main ideas, and specific information using listening and reading strategies.
CO3	Apply appropriate vocabulary, structures, and communication skills in speaking and writing using real-world inputs such as audio materials and newspapers.
I-I	Course Code: C107 Course Name Applied Chemistry Lab
CO1	Acquire practical skills in volumetric, redox, and EDTA titrations for chemical analysis.
CO2	Gain exposure to modern instrumental techniques such as pH-metry, conductometry, potentiometry, and colorimetric methods.
CO3	Develop experimental capabilities to estimate water hardness, acid content, and prepare simple polymer compounds.



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I-I	Course Code: C108 Course Name: I.T Workshop
CO1	Assemble/disassemble PC components, set up virtual machines, execute Linux commands, and configure basic computer networking.
CO2	Apply computer security measures, utilize platform code-hosting tools, and leverage productivity tools for media and text extraction.
CO3	Use modern office suites, LaTeX, cloud collaboration platforms, and web development resources efficiently.
I-II	Course Code: C110 Course Name Mathematics –II (Linear Algebra and Numerical Methods)
CO1	Develop the use of matrix algebra techniques that is needed by engineers for practical applications
CO2	Solve systems of linear equations using appropriate methods.
CO3	Evaluate approximating the roots of polynomial and transcendental equations by different algorithms
CO4	Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals
CO5	Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations
I-II	Course Code: C111 Course Name – Mathematics – III
CO1	Interpret the physical meaning of different operators such as gradient, curl and divergence and estimate the work done against a field, circulation and flux using vector calculus
CO2	Apply the Laplace transform for solving differential equations
CO3	Find or compute the Fourier series of periodic signals
CO4	Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms
CO5	Identify solution methods for partial differential equations that model physical processes
I-II	Course Code: C112 Course Name –Applied Physics
CO1	Analyze the principles of wave optics including interference in thin films, Newton's rings, and diffraction phenomena to determine the resolving power of optical instruments.
CO2	Apply wave-particle duality and Schrödinger's wave equations to describe quantum mechanical concepts and calculate energy levels of a particle in a potential box.
CO3	Evaluate classical and quantum free electron theories, Fermi-Dirac distribution, and Kronig-Penney band theory to classify solids and explain electron behavior.



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CO4	Interpret carrier concentrations, Fermi level variations, and transport phenomena in semiconductors, utilizing the Hall effect to identify semiconductor properties.
CO5	Explain dielectric polarization mechanisms, the Clausius-Mossotti relation, and magnetic domains to categorize materials for industrial and magnetic device applications.
I-II	Course Code: C113 Course Name: -Programming for Problem Solving using C
CO1	Understand basic computer organization, number representation, fundamental elements of C programming, and expression evaluation using precedence and associativity
CO2	Develop structured C programs using bitwise operators, decision-making control statements, and iterative looping constructs for various computational problems
CO3	Implement contiguous data collections using single and multidimensional arrays, manipulate strings using library functions, and define user-defined data types using structures and unions
CO4	Apply pointer concepts, perform pointer arithmetic, dynamic memory allocation, and utilize preprocessor directives for memory-efficient programming.
CO5	Modularize programs using user-defined functions and recursion, and execute file handling operations on text and binary streams.
I-II	Course Code: C114 Course Name: – Digital Logic Design
CO1	Demonstrate proficiency in number system conversions, signed binary arithmetic, and various 4-bit digital codes including BCD and Excess-3.
CO2	Simplify Boolean functions and implement optimized logic circuits using Boolean theorems, K-Map techniques, and universal gates.
CO3	Analyze and design combinational logic circuits like adders, multiplexers, and decoders, and implement switching functions using programmable logic devices.
CO4	Analyze the operation of latches and flip-flops, construct truth/excitation tables, and perform conversions between different flip-flop types
CO5	Design and evaluate synchronous and asynchronous sequential circuits including shift registers, ripple counters, and specialized counters.
I-II	Course Code: C115 Course Name: -Applied Physics Lab
CO1	Measure optical properties of materials including light wavelengths, thin-film thickness, lens curvature, dispersive power, and resolving powers using interference and diffraction techniques.
CO2	Evaluate magnetic and electrical characteristics by analyzing the magnetic field of current-carrying coils, Gouy's susceptibility, B-H hysteresis loops, and thermistor temperature coefficients.
CO3	Analyze fundamental semiconductor and dielectric parameters using energy bandgap



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	calculations, four-probe resistivity, Hall coefficient determination, and dielectric constant measurements.
I-II	Course Code: C116 Course Name: – Communication Skills Lab
CO1	Develop effective spoken communication skills through JAM sessions, role plays, hypothetical scenarios, and telephonic etiquette while refining pronunciation and neutralizing accents
CO2	Apply structured oral presentation techniques, public speaking skills, and data interpretation strategies to deliver impactful individual and poster presentations
CO3	Master interactive professional skills required for successful group discussion participation, mock interviews, and fluent connected speech.
I-II	Course Code: C117 Course Name: -Programming for Problem Solving using C Lab
CO1	Develop fundamental C programs using standard input/output, formatted printing, mathematical operators, and conditional decision-making structures.
CO2	Apply iterative loops, single/multidimensional arrays, string manipulations, and matrix operations to implement modular computational solutions.
CO3	Utilize dynamic memory allocation, user-defined functions, pointer operations, and standard file I/O functions to build memory-efficient applications.
I-II	Course Code: C118 Course Name: - Engineering Exploration Project
CO1	Understand design thinking principles, cultivate a user-centered designer mindset through podcasts and bag challenges, and collaborate effectively in multidisciplinary teams across varied engineering streams
CO2	Execute field interviews, empathize with target users, define core problem statements, and generate innovative ideas through structured brainstorming sessions.
CO3	Construct tangible prototypes for selected stream challenges, test solutions through user feedback, iterate based on constructive criticism, and deliver final project reports and presentations
II-I	Course Code: C201 Course Name: -Mathematical Foundations of Computer Science
CO1	Apply mathematical logic, truth tables, normal forms, and rules of inference to evaluate the validity of logical arguments in propositional and predicate calculus.
CO2	Analyze set operations, equivalence and partial ordering relations, functions, lattice structures, and fundamental algebraic systems like groups and monoids.
CO3	Solve counting problems using combinatorics principles and apply fundamental number theory algorithms, modular arithmetic, and theorems to computational problems.
CO4	Formulate and solve homogeneous and inhomogeneous recurrence relations using



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	characteristic roots, substitution methods, and generating functions
CO5	Demonstrate graph concepts, matrix representations, traversals, planar graphs, coloring, and minimum spanning tree algorithms for solving discrete computational problems.
II-I	Course Code: C202 Course Name: – Software Engineering
CO1	Understand software engineering principles, process frameworks, prescriptive and specialized process models, and personal/team software processes.
CO2	Apply Agile process models, Extreme Programming, and core framework principles to establish, elicit, negotiate, and validate software requirements.
CO3	Analyze software requirements using scenario-based, class-based, flow-oriented, and behavioral modeling techniques with UML for traditional and WebApp systems.
CO4	Design software system architectures, mapping data flows, and designing class-based and traditional components for component-based software development
CO5	Apply user interface design principles, software quality assurance metrics, and testing strategies using white-box and basis path testing methodologies.
II-I	Course Code: C203 Course Name: – Python Programming
CO1	Understand basic Python programming concepts, variable declarations, data types, arithmetic operators, decision-making constructs, and iterative loops.
CO2	Apply control flow structures, string manipulation methods, data encryption techniques, and text file operations in Python programs.
CO3	Develop modular Python applications using dynamic data structures like lists and dictionaries, top-down function designs, recursion, and reusable packages.
CO4	Implement object-oriented programming concepts including classes, inheritance, polymorphism, operator overloading, dynamic attributes, and file pointer manipulations.
CO5	Analyze robust Python programs using exception handling mechanisms, build graphical user interfaces (GUI), and utilize visual programming concepts in Scratch.
II-I	Course Code: C204 Course Name: – Data Structures
CO1	Analyze time and space complexities of algorithms, abstract data types, searching methods, and dynamic sorting techniques like insertion, quick, radix, and merge sort.
CO2	Implement operations on single, double, and circular linked lists, applying them to polynomial arithmetic and sparse matrix representations.
CO3	Construct stack and queue data structures using arrays and linked lists to solve applications including infix-to-postfix conversions and expression evaluation.
CO4	Apply fundamental tree concepts, binary search tree operations, expression trees, heap sort, and rotation mechanisms in balanced AVL trees.



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CO5	Model graph representations, traversals (BFS/DFS), and graph algorithms for finding minimum spanning trees, shortest paths, and transitive closures.
II-I	Course Code: C205 Course Name: -Object Oriented Programming through C++
CO1	Understand the paradigm shift from procedural to object-oriented programming, emphasizing key concepts, advantages, and language features of C++.
CO2	Apply object-oriented concepts to construct classes, instantiate objects, define member functions, and implement constructors and destructors.
CO3	Implement operator overloading, user-defined type conversions, and inheritance hierarchies using abstract and virtual base classes.
CO4	Analyze dynamic memory management using pointers, this pointer, dynamic binding, virtual functions, and virtual destructors.
CO5	Develop generic code using templates, handle runtime errors with exception handling constructs, and utilize Standard Template Library (STL) containers and algorithms.
II-I	Course Code: C206 Course Name: – Computer Organization
CO1	Understand basic computer organization, bus structures, data representation models, and implement binary computer arithmetic operations
CO2	Analyze register transfer language, micro-operations, instruction cycles, and complete basic computer instruction execution
CO3	Design CPU organizations, instruction formats, addressing modes, and microprogrammed control units.
CO4	Evaluate memory hierarchy architectures, cache/virtual memory management, and input-output data transfer mechanisms.
CO5	Analyze multiprocessor interconnection structures, inter-processor arbitration, and parallel processing techniques including instruction pipelining.
II-I	Course Code: C207 Course Name: – Python Programming Lab
CO1	Develop basic Python scripts utilizing variables, input/output operations, mathematical calculations, loops, conditional logic, and string manipulation routines.
CO2	Implement structured problem-solving solutions using list operations, custom reusable functions, mathematical algorithms, and text file processing techniques.
CO3	Design object-oriented applications using classes, encapsulation, GUI components, file dialogs, and robust exception handling mechanisms
II-I	Course Code: C208 Course Name: --Data Structures through C++ Lab
CO1	Develop object-oriented C++ programs utilizing classes, constructors, function/operator



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	overloading, access specifiers, and generic templates to model dynamic data entities.
CO2	Implement multi-level and hybrid inheritance structures along with robust exception handling techniques, friend functions, and explicit pointer usage.
CO3	Construct C programs executing searching algorithms, sorting techniques, linear linked lists, stack/queue operations, and binary search tree traversals
II-II	Course Code: C211 Course Name: -Probability and Statistics
CO1	Analyze descriptive statistics, data visualization techniques, measures of central tendency, variability, skewness, and kurtosis to summarize sample data.
CO2	Evaluate linear/rank correlations and fit mathematical curves including lines, parabolas, exponentials, and power curves using the method of least squares.
CO3	Apply probability rules, Bayes' theorem, expectations, and standard distributions (Binomial, Poisson, Uniform, Normal) to model random variables
CO4	Understand sampling distributions, estimation techniques, maximum error bounds, and the Central Limit Theorem across normal and derived sampling distributions.
CO5	Execute hypothesis testing for single/two means and proportions using large and small sample test statistics to draw statistical conclusions.
II-II	Course Code: C212 Course Name: -Java Programming
CO1	Demonstrate core Java fundamentals, data types, control flow structures, and operators to write basic interactive applications.
CO2	Implement object-oriented programming concepts using classes, objects, method overloading/overriding, access modifiers, constructors, and static/final keywords.
CO3	Construct single and multidimensional array operations, implement inheritance hierarchies, dynamic method dispatch, and interface structures.
CO4	Organize code using custom and standard Java SE packages, manage system resources, and design robust error-handling mechanisms using exceptions.
CO5	Apply Java string manipulation utilities, implement multithreaded concurrent programs with synchronization, and establish database connectivity using JDBC.
II-II	Course Code: C213 Course Name: – Operating Systems
CO1	Understand operating system architectures, core functions, services, system call mechanisms, and system boot procedures.
CO2	Analyze process concepts, multithreading models, CPU scheduling algorithms, and inter-process synchronization primitives for solving classical IPC problems.
CO3	Evaluate main memory management techniques including paging and segmentation, as well as virtual memory strategies like demand paging and page replacement algorithms.



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CO4	Apply deadlock prevention, avoidance, detection, and recovery strategies while managing file systems, disk scheduling algorithms, and secondary storage structures.
CO5	Analyze system protection mechanisms, access control models, security defense strategies, and real-world operating system case studies like Linux and Windows.
II-II	Course Code: C214 Course Name: -Database Management Systems
CO1	Understand basic database concepts, file system limitations, data independence, data models, and the three-schema architecture of database systems.
CO2	Apply relational model concepts, integrity constraints, and basic SQL commands (DDL/DML) for database definition, manipulation, and querying.
CO3	Design ER diagrams incorporating entities, relationships, and inheritance, and execute complex SQL operations including nested queries, aggregations, views, and joins.
CO4	Analyze schema refinement techniques and evaluate functional dependencies to decompose relational schemas up to 5NF and BCNF.
CO5	Analyze transaction management concepts, concurrency control, serializability, recovery algorithms, and file indexing techniques using B+ trees and hashing.
II-II	Course Code: C215 Course Name: -Formal Languages and Automata Theory
CO1	Construct Deterministic and Non-Deterministic Finite Automata, minimize state transitions, and convert between DFAs, NFAs, and Mealy/Moore finite state machines.
CO2	Analyze regular expressions, regular sets, formal grammar classifications, and the Chomsky hierarchy, applying the Pumping Lemma to prove non-regularity.
CO3	Design Context-Free Grammars, construct leftmost/rightmost derivations and parse trees, and simplify CFGs into Chomsky and Greibach Normal Forms.
CO4	Design deterministic and non-deterministic Pushdown Automata to model context-free languages and establish equivalence between PDAs and CFGs.
CO5	Model computation using Turing Machines, analyze decidability and limits of computation (Halting Problem/PCP), and classify computational complexity into P, NP, NP-Hard, and NP-Complete classes.
II-II	Course Code: C216 Course Name: -Java Programming Lab
CO1	Develop Java applications utilizing core syntax, primitive data types, control flow statements, arrays, string manipulations, and basic searching/sorting algorithms.
CO2	Apply object-oriented concepts including class design, constructor and method overloading, single/multilevel inheritance, abstract classes, interfaces, and package management.
CO3	Implement multithreaded concurrent programs with thread synchronization, robust built-in and user-defined exception handling mechanisms, and GUI applets with event handling.



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II-II	Course Code: C217	Course Name: -UNIX Operating System Lab
CO1	Utilize Unix/Linux utility commands, shell environments, VI editor operations, file system structures, and environment variable configurations.	
CO2	Write C programs using POSIX system calls and the standard I/O library to perform file operations, emulate system utilities, manage process creation, and implement inter-process communication via pipes and shared memory.	
CO3	Simulate core operating system algorithms including CPU scheduling, memory management models (MFT/MVT), page replacement strategies, file allocation methods, deadlock avoidance/prevention, and thread synchronization using semaphores and p threads.	
II-II	Course Code: C218	Course Name: -Database Management Systems Lab
CO1	Construct relational tables using DDL commands and integrity constraints, and execute complex SQL queries involving subqueries, set operators, scalar functions, and aggregate groupings.	
CO2	Develop procedural PL/SQL blocks using control flow structures, exception handling mechanisms, cursors, parameter passing, and explicit transaction control commands.	
CO3	Implement advanced database objects such as stored procedures, user-defined functions, triggers, database views, and indexing structures for optimized data retrieval.	
II-II	Course Code: C220	Course Name: – Socially Relevant Project
CO1	Identify community needs, analyze societal problems, apply appropriate engineering solutions, and prepare comprehensive project documentation demonstrating measurable community impact.	
CO2	Demonstrate effective teamwork, leadership, communication, and presentation skills while planning, executing, and presenting community-based projects.	
CO3	Evaluate the societal, ethical, environmental, and sustainability aspects of community projects and recommend responsible engineering practices for long-term societal benefit	
III-I	Course Code: C301	Course Name: -Data Warehousing and Data Mining
CO1	Analyze data warehousing architectures, multidimensional data models, schema designs, and OLAP operations to support business decision-making systems.	
CO2	Apply data preprocessing techniques, statistical descriptions, and distance measures to clean, integrate, transform, and visualize raw data for knowledge discovery.	
CO3	Evaluate frequent item sets, association rules, and correlation patterns using algorithms like Apriori and FP-Growth in multi-level and multi-dimensional spaces.	
CO4	Design and evaluate predictive classification models including Decision Trees, Naïve Bayes, Support Vector Machines, and Neural Networks using model selection metrics	
CO5	Implement partitioning, hierarchical, density-based, grid-based clustering algorithms, and	



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	outlier detection methods to extract patterns from complex datasets.
III-I	Course Code: C302 Course Name: -Computer Networks
CO1	Understand computer networking history, network topologies, communication paradigms, and compare the layered architectures of the OSI and TCP/IP reference models.
CO2	Analyze physical layer signal encoding, modulation, and multiplexing techniques while implementing data link layer framing, error/flow control mechanisms, and media access control protocols.
CO3	Evaluate local and personal area network standards including Ethernet variants, Token Ring, Bluetooth, Wi-Fi, and Wi-MAX alongside error detection schemes like CRC.
CO4	Apply network layer protocols (IPv4, IPv6, ARP, ICMP), addressing strategies (subnetting, CIDR, NAT), and routing algorithms (Distance Vector, Link State) for efficient packet delivery.
CO5	Analyze transport layer protocols (TCP/UDP), connection management, flow/congestion control mechanisms, basic queuing models, and standard application layer services and protocols.
III-I	Course Code: C303 Course Name: -Compiler Design
CO1	Understand the multi-phase structure of compilers and design lexical analyzers using regular expressions, finite automata, and generator tools like LEX.
CO2	Analyze context-free grammars to construct top-down (LL) and bottom-up (LR, SLR, LALR) parsers for syntax analysis.
CO3	Implement syntax-directed translation definitions to generate intermediate code forms, including three-address code, syntax trees, and type-checking schemes.
CO4	Evaluate runtime memory management structures, garbage collection strategies, and perform machine-independent code optimizations using data-flow analysis.
CO5	Design target code generation mechanisms incorporating register allocation, basic block flow graphs, and machine-dependent peephole optimizations.
III-I	Course Code: C304 Course Name: – Artificial Intelligence
CO1	Understand the history, foundations, current trends, and core paradigms of Artificial Intelligence alongside early domain applications.
CO2	Solve first-order differential equations and apply them to engineering problems. Apply state-space search strategies, heuristic algorithms (IDA*), constraint satisfaction techniques, and game-playing methods like Alpha-Beta pruning to solve complex problems.
CO3	Analyze propositional and predicate logic systems using deduction techniques, axiomatic rules, semantic tableaux, and resolution refutation.
CO4	Construct structured knowledge representation models using semantic networks, frames,



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	conceptual dependency structures, scripts, and semantic web technologies.
CO5	Evaluate expert system architectures, probabilistic uncertainty models (Bayesian networks, Dempster-Shafer theory), and fuzzy logic inference mechanisms.
III-I	Course Code: C305 Course Name: -Professional Elective-I Software Testing Methodologies
CO1	Understand fundamental software testing concepts, software quality assurance, testing terminology, and life cycle models.
CO2	Apply black-box and white-box testing strategies (Boundary Value Analysis, Equivalence Partitioning, Path Testing, Data Flow Testing) to design effective test cases.
CO3	Analyze test coverage, control flow graphs, logic-based testing, and system integration strategies to detect software defects and vulnerabilities.
CO4	Evaluate automated testing frameworks, performance testing tools, static/dynamic analysis tools, and bug-tracking mechanisms.
CO5	Collaborate in technical teams to construct comprehensive test plans, execute test suites, document bug reports, and assess software quality for complex applications.
III-I	Course Code: C306 Course Name: -Computer Networks Lab
CO1	Implement data link layer framing algorithms (character and bit stuffing), error detection mechanisms using CRC polynomials, and flow control techniques like sliding window protocols.
CO2	Develop network applications using C socket programming to implement DNS resolution, UDP-based chat applications, ARP MAC address retrieval, and raw socket packet capturing/filtering.
CO3	Analyze and simulate core routing algorithms and protocols, including Dijkstra's shortest path, Distance Vector routing, Broadcast Trees, OSPF path costing, and BGP inter-domain routing.
III-I	Course Code: C307 Course Name: – AI Tools and Techniques Lab
CO1	Understand basic logic programming concepts, temperature conversions, and factual knowledge representation using Prolog syntax, predicates, and cut control operators.
CO2	Apply declarative programming paradigms in Prolog and LISP to implement recursive mathematical computations, medical diagnostic expert systems, and classic AI state-space search problems like the Monkey-Banana problem.
CO3	Implement state-space search strategies (DFS, BFS, Hill Climbing, and A* algorithms) in Prolog/LISP to solve complex algorithmic puzzles including the 4-Queen, 8-Puzzle, Water Jug, Towers of Hanoi, and Traveling Salesman problems.



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III-I	Course Code: C308	Course Name: -Data Mining Lab
CO1	Execute core R environment commands, manage tabular data structures (Data Frames), handle CSV file I/O operations, and perform data cleaning and slicing tasks.	
CO2	Compute and visualize descriptive statistical measures using R plotting functions (histograms, boxplots, scatter plots) and apply normalization transformations (min-max, z-score) using vectorized apply functions.	
CO3	Implement machine learning algorithms in R including linear/multiple regression models, decision trees, text mining (corpus term matrices), and clustering methods (K-Means, K-Medoids, DBSCAN).	
III-II	Course Code: C310	Course Name: – Web Technologies
CO1	Design responsive web pages using modern HTML5 structural elements, semantic tags, forms, media, dynamic HTML, and CSS3 box-model styling rules.	
CO2	Develop client-side and server-side interactive web components using JavaScript, regular expressions, AngularJS form validation, and Node.js module architecture.	
CO3	Implement structured data formats using XML schemas, DTD, DOM/SAX parsing models, and asynchronous web applications using AJAX and PHP integration.	
CO4	Construct server-side web scripts in PHP using variables, control flow structures, arrays, dynamic functions, and operator mechanisms.	
CO5	Deploy web applications on servers (XAMPP, Tomcat), integrate database connections using Servlets, JSP, PHP, MongoDB, and utilize modern frameworks like Ruby on Rails.	
III-II	Course Code: C311	Course Name: – Distributed Systems
CO1	Understand the core principles, models, and design challenges of distributed systems, including execution models, global state cuts, and logical/physical clock synchronization mechanisms.	
CO2	Analyze message ordering paradigms (causal and total order), group communication, and snapshot recording algorithms for capturing global states over FIFO channels.	
CO3	Apply distributed mutual exclusion algorithms (Lamport, Ricart-Agrawala, Maekawa, Suzuki-Kasami) and evaluate deadlock detection algorithms across single resource, AND, and OR models.	
CO4	Evaluate failure recovery techniques, including checkpointing and log-based rollback, and consensus/agreement algorithms operating in synchronous failure-prone environments.	
CO5	Analyze peer-to-peer overlay networks (Chord, CAN, Tapestry) and distributed shared memory concepts, including memory consistency models and mutual exclusion mechanisms.	
III-II	Course Code: C313	Course Name: -Professional Elective-II NPTEL/SWAYAM



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CO1	Apply engineering knowledge and modern tools to analyze industrial practices and solve engineering problems.
CO2	Demonstrate the ability to acquire and apply specialized knowledge through NPTEL/SWAYAM Course Codes to address engineering and professional challenges.
CO3	Analyze and interpret concepts learned through online Course Codes and relate them to real-world engineering applications and industry requirements.
CO4	Prepare technical reports and present Course Code outcomes effectively using professional communication skills.
CO5	Evaluate professional learning experiences, demonstrate ethics and teamwork, and reflect on professional growth for lifelong learning.
III-II	Course Code: C314 Course Name: -Open Elective-I Renewable Energy Sources
CO1	Understand the core principles, global energy scenarios, and working mechanisms of various non-conventional and renewable energy technologies.
CO2	Analyze solar radiation geometry, solar thermal systems, and photovoltaic performance to estimate energy yields for practical applications.
CO3	Evaluate wind energy potential, aerodynamic principles, site selection parameters, and performance characteristics of wind turbine generators.
CO4	Examine bio-energy conversion pathways, geothermal systems, ocean/tidal energy extraction mechanisms, and fuel cell technologies.
CO5	Design and assess hybrid renewable energy systems for grid-tied or off-grid power generation while evaluating economic feasibility, environmental impact, and sustainability.
III-II	Course Code: C315 Course Name: -Managerial Economics and Financial Accountancy
CO1	Understand fundamental concepts of managerial economics, microeconomic principles, market structures, and demand analysis for business decision-making.
CO2	Evaluate elasticity of demand, production functions, and cost-volume-profit relationships using Break-Even Analysis to optimize operational costs.
CO3	Analyze different market structures, business organization structures, pricing strategies, and macroeconomic factors impacting enterprise stability.
CO4	Apply double-entry bookkeeping, prepare financial statements, and execute financial ratio analysis to assess corporate liquidity and performance.
CO5	Evaluate capital expenditure proposals and long-term project viability using discounted and non-discounted capital budgeting techniques.
III-II	Course Code: C316 Course Name: – Web Technologies Lab
CO1	Design and build responsive, interactive user interfaces using client-side web technologies (HTML5, CSS3, JavaScript, DOM, AJAX).



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CO2	Construct structured XML documents validated against Document Type Definitions (DTD) and XML Schema Definitions (XSD), and implement asynchronous web interactions using AJAX..
CO3	Develop dynamic web applications and web services using PHP, Servlets, and JSP with server-side authentication, session management, cookies, and database connectivity.
III-II	Course Code: C317 Course Name: -Industrial Training / Skill Development Programmes / Research Project in higher learning institutes
CO1	Apply engineering knowledge and modern tools to analyze industrial practices and solve engineering problems
CO2	Prepare technical reports and present internship outcomes effectively using professional communication skills.
CO3	Evaluate industrial experiences, demonstrate ethics and teamwork, and reflect on professional growth for lifelong learning.
IV-I	Course Code: C401 Course Name: - Cryptography and Network Security
CO1	Understand classical encryption techniques, security services, block cipher design principles, and common cyber threats including web, memory, and session vulnerabilities.
CO2	Apply symmetric key cryptography algorithms (DES, AES, Blowfish, IDEA) across various block cipher modes of operation using foundational mathematical principles of number theory.
CO3	Evaluate public key cryptosystems (RSA, Diffie-Hellman, ECC), cryptographic hash functions, message authentication codes (HMAC, CMAC), and digital signature standards for secure key management and verification.
CO4	Analyze user authentication mechanisms (Kerberos), email security standards (PGP, S/MIME), and network-layer security protocols
CO5	Design transport-layer security architectures (SSL, TLS, SSH) and configure firewall protection strategies for safe web communications and system boundaries.
IV-I	Course Code: C402 Course Name: – UML & Design Patterns
CO1	Understand the core principles of UML modeling, standard SDLC architectures, class relationships, and construct structural UML diagrams for object-oriented software design.
CO2	Model dynamic system behaviors using interaction diagrams, use case scenarios, activity workflows, and state chart diagrams to capture state transitions and event signals.
CO3	Analyze architectural system components using component and deployment diagrams while evaluating software design pattern catalogs, classifications, and selection strategies.
CO4	Apply creational patterns (Factory Method, Abstract Factory, Builder, Prototype, Singleton) and structural patterns (Adapter, Bridge, Composite, Decorator, Facade, Flyweight, Proxy)



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	to solve software structural problems.
CO5	Implement behavioral design patterns (Chain of Responsibility, Command, Iterator, Mediator, Observer, Strategy, Template Method) to streamline object communication, state control, and algorithmic responsibilities.
IV-I	Course Code: C403 Course Name: – Machine Learning
CO1	Understand the core goals and applications of machine learning, concept representation, inductive classification, hypothesis space search, and the candidate elimination algorithm.
CO2	Apply Decision Tree learning algorithms using entropy, information gain, and pruning strategies, while evaluating performance using statistical validation techniques.
CO3	Analyze computational learning theory concepts (PAC learning, VC dimension) and implement heuristic rule induction alongside Inductive Logic Programming techniques.
CO4	Construct Artificial Neural Networks with backpropagation and design Support Vector Machines using kernel methods for linear and non-linear classification.
CO5	Implement probabilistic Bayesian models (Naive Bayes, Bayes Nets), Logistic Regression, and memory-based Instance-Based Learning algorithms such as k-Nearest-Neighbors.
IV-I	Course Code: C404 Course Name:-Open Elective –II Embedded Systems
CO1	Understand the core architecture, memory organization, peripherals, and instruction sets of microcontrollers/processors used in embedded systems.
CO2	Analyze hardware-software trade-offs, bus protocols (SPI, I2C, UART, CAN), and real-time constraints to design embedded solutions.
CO3	Develop Embedded C/Assembly programs and interface sensors, actuators, and communication modules with microcontrollers.
CO4	Apply Real-Time Operating System (RTOS) concepts such as task scheduling, inter-process communication, and resource management to complex embedded systems.
CO5	Design, build, and test embedded hardware-software prototypes for real-world applications in collaboration with teams while adhering to safety and ethical standards.
IV-I	Course Code: C405 Course Name: -Professional Elective-III Software Project Management
CO1	Analyze conventional software management models and apply software economic principles to improve cost estimation, process efficiency, team productivity, and quality assurance.
CO2	Understand the transition from conventional software engineering to modern iterative management across life cycle phases (Inception, Elaboration, Construction, Transition) and management/engineering artifact sets.
CO3	Evaluate model-based software architectures, process workflows, and milestone checkpoints



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	for effective project monitoring and status assessment.
CO4	Design iterative project plans using Work Breakdown Structures (WBS), pragmatic estimation guidelines, and organizational structures tailored to evolving software projects.
CO5	Utilize process automation tools, core software metrics, COCOMO estimation models, and network analysis techniques (PERT, CPM, Monte Carlo) to measure and control software project performance.
IV-I	Course Code: C406 Course Name: - Professional Elective-IV Cloud Computing
CO1	Understand the core principles of network-centric computing, cloud delivery models, ethical challenges, and underlying parallel and distributed system architectures
CO2	Compare public cloud infrastructure platforms (AWS, Google Cloud, Azure, Open Source), architectural styles, workflows, ZooKeeper orchestration, and ecological/licensing challenges.
CO3	Analyze virtualization mechanisms (Full, Para-virtualization, Hypervisors/VMMs), performance isolation, control-theory-based resource management, dynamic application scaling, and MapReduce scheduling policies.
CO4	Evaluate cloud storage architectures (GFS, BigTable, Apache Hadoop, Amazon S3) alongside cloud security frameworks, privacy impact assessments, and virtual machine isolation security risks.
CO5	Develop cloud applications and distributed services using platform tools like AWS (EC2, S3), Google App Engine, Google Web Toolkit, and Microsoft Azure ecosystem services.
IV-I	Course Code: C407 Course Name: -UML Lab
CO1	Analyze software requirements to construct structural UML diagrams (Class, Object, Component, Deployment) using modern CASE tools.
CO2	Model dynamic system behaviors and interaction workflows using behavioral UML diagrams (Use Case, Sequence, Collaboration, State Chart, Activity).
CO3	Collaborate in technical teams to design, reverse/forward engineer, document, and present object-oriented software system architectures for complex real-world problems.
IV-I	Course Code: C408 Course Name: -Project -I
CO1	Apply engineering knowledge and modern tools to analyze industrial practices and solve engineering problems
CO2	Prepare technical reports and present internship outcomes effectively using professional communication skills.
CO3	Evaluate industrial experiences, demonstrate ethics and teamwork, and reflect on professional growth for lifelong learning.

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IV-II	Course Code: C410 – Management and Organizational Behavior
CO1	Understand fundamental management functions, organizational structures, and theoretical principles of organizational behavior.
CO2	Analyze individual and group dynamics, personality traits, perception, and motivational theories to solve human resource and behavioral challenges.
CO3	Apply leadership styles, decision-making frameworks, conflict resolution strategies, and communication techniques in diverse team environments.
CO4	Evaluate organizational culture, climate, dynamic stress management techniques, and change management processes for sustained workplace performance.
CO5	Demonstrate ethical behavior, social responsibility, professional standards, and effective management of multidisciplinary projects.
IV-II	Course Code: C411 Course Name: -Open Elective –III Entrepreneurship
CO1	Understand the core concepts of entrepreneurship, business models, opportunity identification, and market analysis.
CO2	Formulate and analyze business plans, feasibility reports, and market strategies for viable venture creation.
CO3	Design and develop sustainable business solutions, product/service prototypes, and operational processes considering economic and social impact.
CO4	Apply financial management principles, capital budgeting, cost analysis, and resource planning for managing new ventures.
CO5	Demonstrate ethical leadership, team collaboration, effective business communication, and lifelong learning for successful venture sustainability.
IV-II	Course Code: C411 Course Name: -Professional Elective-IV Big Data Analytics
CO1	Understand the core concepts of Big Data platforms, the limitations of conventional data systems, the nature of data, and the distinction between data analysis and reporting.
CO2	Apply stream processing algorithms and architectures to compute stream data models, perform window-based filtering and counting, and implement real-time analytics for sentiment analysis and stock market applications.
CO3	Analyze the architecture of the Hadoop Distributed File System (HDFS) and develop MapReduce applications to handle job execution, scheduling, scaling, and fault tolerance.
CO4	Utilize high-level Big Data frameworks including Apache Pig operators, HiveQL query execution, and the basic infrastructure of HBase and ZooKeeper for distributed data handling.
CO5	Implement simple and multiple linear regression models for predictive analytics and apply visual data analysis techniques to interpret complex data patterns.



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IV-II	Course Code: C411 Course Name: – Project-II
CO1	Identify, analyze, and formulate real-world engineering problems through literature survey, and design appropriate solutions using relevant engineering tools and methodologies.
CO2	Implement, test, and evaluate the proposed solution while demonstrating teamwork, project management skills, and adherence to professional ethics.
CO3	Communicate project outcomes effectively through technical reports and presentations, and assess societal, environmental, and sustainability impacts of the solution