# COMPUTER SCIENCE MAJOR
# CLASS OF 2023

# ACADEMIC DOSSIER

# OFFICE OF UNDERGRADUATE EDUCATION & ACCREDITATION

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# COMPUTER SCIENCE

## PROGRAM DESCRIPTION:

Computer Science (CS) is the study of computation - what can and cannot be computed, how computation can be made more efficient, how to build machines that can compute, and which spheres of human activity can benefit from computational approaches. It is deeply rooted in logic and mathematics. Theoretical Computer Scientists push the frontiers of computation by inventing new computational approaches. Practical Computer Scientists apply the theory of Computer Science to different application areas like science, finance, medicine, business, transportation, entertainment, education, communication, engineering, art, and the humanities.

Interventions stemming from CS are just beginning to disrupt and reinvent Pakistani society. The CS program provides students the intellectual and technical foundation to assess these interventions and to contribute meaningfully and thoughtfully to the transition of our society to the information age. With an education grounded in the Liberal Arts, our graduates have an unrivalled understanding of our society and the ethical ramifications of technology.

A major with the program educates students in the theory, systems, and applications of CS so that they are able and willing to make impactful contributions to society and are prepared for success in industry, entrepreneurship, and higher education.

## PROGRAM EDUCATIONAL OBJECTIVES:

Computer Science program at Habib University aims to produce competent computer scientists who;

1. Have strong foundational knowledge of mathematics and computer science, and the accompanying skills both in breadth and in depth, to position themselves equally well in the Information Technology industry, as technology entrepreneurs and/or in graduate programs in Computer Science or other technical and scientific fields.
2. Have a hands-on approach to self-learning and research, and will continually update their knowledge, skills and technical know-how.
3. Will be able to assess the societal, cultural, social, religious, legal, environmental, local, and global impact of their actions and will choose an ethical course of action in their professional, personal, and daily lives.
4. Will be able to effectively communicate and collaborate with people from diverse backgrounds and in a variety of settings.

# PROGRAM LEARNING OUTCOMES:

Upon graduation, students will have the following abilities:

1. Analysis: analyze a given situation and reduce it to one or more problems that can be solved via computer intervention.
2. Design: design one or more computer-based solutions of a given problem and select the solution that is best under the circumstances.
3. Programming: program a given solution in a variety of programming languages belonging to different paradigm.
4. Implementation: design and implement software systems of varying complexity.
5. Tools: work with the latest tools that support development, e.g., IDE's, version control systems, debuggers, profilers, and continuous build systems.
6. Self-learning: research, learn, and apply requirements needed to implement a solution for a given high level problem description.
7. Ethics and Awareness: foresee both impact and possible ramifications of computing practices.
8. Communication and Teamwork: work effectively in inter-disciplinary teams.

# MAPPING OF PLOS TO UNIVERSITY LEARNING GOALS:

## PROGRAM LEARNING OUTCOMES - MAPPING

| | | | University Learning Goals (ULG) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Know* | | | *Act* | | | *Value* | | |
| | | | **Knowledge** | ***Interdisciplinary &*** | ***Context*** | ***Creativity &*** | ***Critical Inquiry*** | ***Communication &*** | ***Social Impact*** | ***Thought*** | ***Ethical & Cultural*** |
| | | | *Breadth & Depth* | *Synthesis & Connections* | *Contextually Grounded* | *Imaginative & Interesting* | *Analysis & Critical Thought* | *Interaction & Teamwork* | *Service & Sustainability* | *Yohsin Values & Lifelong Learning* | *Personal & Professional Ethics* |
| | | | ULG 01 | ULG 02 | ULG 03 | ULG 04 | ULG 05 | ULG 06 | ULG 07 | ULG 08 | ULG 09 |
| **PLO** | **Title** | **Program Learning Outcomes** | Demonstrate both a genuine breadth of knowledge through the Habib Liberal Core and a capable depth of knowledge through command of their chosen major. | Synthesize knowledge, methods and viewpoints from different disciplines to both make meaningful connections among and transcend them. | Demonstrate their knowledge is grounded in a firm understanding of the historical, social, political, economic, religious, regional and global contexts in which they are located. | Imagine, develop and produce creative, original ideas, interpretations and works. | Analyse and formulate relevant critical questions, and answer those questions in a substantive way supported by quantitative and qualitative evidence. | Listen actively to comprehend the meaning of others and successfully express cogent meaning through capable oral, written, and artistic modes of communication. Effectively interact and collaborate with others. | Recognize the reciprocity of knowledge and service, and benefit their community, society and the environment through socially responsible and sustainable engagement. | Cultivate lifelong curiosity by engaging in inquiry and reflection to acquire and apply new knowledge. | Develop and nurture their own beliefs, values and sense of responsibility to reach informed conclusions, while considering, appreciating and respecting the perspectives of others. |
| 1 | Analysis | Analyze a given situation and reduce it to one or more problems that can be solved via computer intervention.s. | S | S | | | S | | | | |
| 2 | Design | Design one or more computer-based solutions of a given problem and select the solution that is best under the circumstances. | | S | W | S | S | | | | |
| 3 | Programming | Program a given solution in a variety of programming languages belonging to different paradigm | | | | S | | | | | |
| 4 | Implementation | Design and implement software systems of varying complexity. | S | | | W | | | | | |
| 5 | Tools | Work with the latest tools that support development, e.g., IDE's, version control systems, debuggers, profilers, and continuous build systems | S | | | | | | | | |
| 6 | Self Learning | Research, learn, and apply requirements needed to implement a solution for a given high level problem description. | | | | W | | | | S | |
| 7 | Ethics & Awarness | Foresee both impact and possible ramifications of computing practices | | | S | | | | S | | S |
| 8 | Communication and Team Work | Work effectively in inter-disciplinary teams. | | | | | | S | | | S |

| ***Legend Competencies*** |
|---|
| **S: Strongly** - Program learning outcome strongly maps to the university learning goal. |
| **W: Weakly** - Program learning outcome weakly maps to the university learning goal. |

# REQUIRED COURSES:

## CS 100: Computer Science Freshman Seminar

Credit Hours: 1+0
Prerequisite: None
Fulfills: CS Major Requirement

Provides a broad overview of the theory and practice of Computer Science.

## CS 101: Programming Fundamentals

Credit Hours: 2+1
Pre-requisite: None
Fulfills: CS Foundation

Motivates computer programming as a means to solve problems; introduces the basic components of problem solving: repetition, decision making, data storage and manipulation, input/output, modularity, top-down design; develops expertise in the corresponding constructs – variables, data types, iteration, conditionals, functions, file and console I/O, and recursion – in a high-level programming language.

## CS 102: Data Structure and Algorithms

Credit Hours: 3+1
Pre-requisite: CS 101 – Programming Fundamentals
Fulfills: CS Foundation

Motivates the design of algorithms by exploring various algorithms for a single task: linear search and binary search, bubble sort, insertion sort, selection sort, merge sort, quick sort; introduces techniques to reason about and compare algorithms: asymptotic analysis and notation, Master theorem; introduces frequently used data structures: list, tree, graph, stack, queue; discusses and analyzes basic operations on the data structures: infix, postfix, and prefix traversal, breadth-first and depth-first search, computation of graph.

## CS 113: Discrete Mathematics

Credit Hours: 3+0
Prerequisite: None
Fulfills: CS Foundation

Equips students with essential mathematical tools that will be encountered in future Computer Science courses; develops a capacity for formal mathematical manipulation and abstract thought; topics include: propositional logic, predicate and quantifiers, sets, functions, sequences, summations, relations, partial orderings, proofs, mathematical induction, pigeonhole principle, permutations and combinations, graphs, graph isomorphism, Euler and Hamiltonian paths, trees.

## CS 201: Data Structures II

Credit Hours: 3+0
Prerequisite: CS 102 – Data Structure and Algorithm and CS 113 – Discrete Mathematics
Fulfills: CS Foundation

Imparts proficiency in the use of commonly used data structures; introduces a few higher level data structures; develops critical judgment regarding the choice of data structures for a given situation; topics include: abstract data type, complexity, stack, queue, list, amortized analysis, array-list, linked list and skip list, hashing, binary tree, binary search tree (BST), randomized BST and trap, self-balancing in trees, AVL tree, B-tree, red-black tree, binary heap and moldable heap, Fibonacci heap, graphs and their representations, graph algorithms, tire, inverted index.

## CS 212: Nature of Computation

Credit Hours: 3+0
Prerequisite: CS 113 – Discrete Mathematics
Fulfills: CS Kernel

Develops the foundations for theoretical computer science; investigates fundamental challenges at the frontiers of theoretical computer science; provides opportunities to develop rigorous mathematical arguments; engages with classical ideas from theoretical computer science; topics include: proofs, languages, finite automata, grammars and push down automata, Turing machines and the halting problem, oracles and computability, Gödel's completeness and incompleteness theorems, circuit complexity, polynomial time and its justification, reduction, P, NP, and NP-completeness, Cook-Levin theorem, hardness of the P versus NP problem, randomness, P versus BPP, interactive proofs, zero knowledge proofs, quantum computing, DNA computing, biological computing, physical limits of computation.

## CS 224: Object Oriented Programming and Design Methodologies

Credit Hours: 3+1
Prerequisite: CS 102 – Data Structure and Algorithms
Fulfils: CS Kernel

Introduces object oriented and related memory concepts; motivates C++ as the language of choice; topics include: pointers and structs, objects, heap allocation, data encapsulation, classes, namespaces, constructors and destructors, virtual functions and destructors, operator overloading and standard input/output, inheritance and polymorphism, templates, standard library containers, and software design using UML 2.0.

## CS 232: Operating Systems

Credit Hours: 3+1
Prerequisite: CS 102 - Data Structure and Algorithms
Fulfils: CS Kernel

The student will be taught principles of modern operating systems. In particular, the course will cover details of concurrent processes, multi-threads, CPU scheduling, memory management, file system, storage subsystem, and input/output management. This will be accomplished by integrating theory and practice through coordinated lecture and lab hours.

## CS 330: Computer Architecture

Credit Hours: 3+1
Prerequisite: EE 172/CS 130 – Digital Logic and Design
Fulfills: CS Kernel

Studies the architecture of RISC-V processor that enables general purpose computing; develops hands-on expertise in developing complex logical components; topics include: instruction set architecture, addressing modes, processor design and computer arithmetic, pipelining, memory systems, fetch execution cycle, processor implementation on FPGA using Verilog HDL.

## CS 353: Software Engineering

Credit Hours: 3+0
Prerequisite: CS 224 – Object Oriented Programming and Design Methodologies and CS 355 – Database Systems
Fulfills: CS Kernel

Approaches software engineering as the study and practice of a collection of concepts, techniques and tools which enable programmers to design, build, and maintain large software systems in a reliable and cost effective way; develops skills and understanding that function as the basis for many of the more advanced analysis and design practices encountered in the industry; topics include: systems development process, stakeholders and their roles, systems development project needs, software process methodologies, spiral and RUP, software analysis and requirement discovery, data modelling, SAD and
OOAD, UML, use case diagrams, software project management, project scope, network diagrams and CPM, agile methodologies, XP, Scrum and FDD, class diagrams, realization of use cases, object-oriented design, sequence diagrams, activity diagrams, state transition diagrams, user interface design, software testing, software construction and maintenance.

## CS 355: Database Systems

Credit Hours: 3+1
Prerequisite: CS 102 - Data Structure and Algorithms
Fulfills: CS Kernel

Explores in detail the theoretical and practical aspects of Relational Database Management Systems (RDBMS); develops an understanding of database modeling, relational algebra, structured query language (SQL), components of Database Management System (DBMS), transaction management and concurrency control, database fine-tuning via indexing and partitioning, and database connectivity with front-end applications; discusses administrative aspects of database systems including database security, database management vs data warehousing vs data mining, and big data and its challenges.

## CS 412: Algorithms: Design and Analysis

Credit Hours: 3+0
Prerequisite: CS 201 – Data Structures II and MATH 310 – Probability and Statistics
Fulfills: CS Kernel

Develops tools and techniques that aid in designing correct, efficient algorithms for computational problems and analyzing their correctness and running time; some of the discussed techniques are: greedy method, divide-and-conquer, dynamic programming, hashing, randomization, network flows, linear programming, Fast Fourier Transform, and techniques for thinking about solving problems in parallel; analysis tools include: recurrences, probabilistic analysis, amortized analysis, and potential functions.

## EE 172/CS 130: Digital Logic and Design

Credit Hours: 3+1
Prerequisites: None
Fulfills: This course meets program requirements for EE Majors

Introduction to the design of digital hardware, realization of computation with logic gates; Boolean algebra, design of combinational logic circuits and analysis and design of clocked sequential logic circuits, circuits for arithmetic operations; introduction to hardware description language and its application to logic design. (Cross-listed with CS 130.)

## CS 491: Kaavish I

Credit Hours: 0+3
Prerequisite: CS 353 – Software Engineering
Fulfills: CS Capstone

Self-directed final year project carried out under the supervision of a faculty member; emphasizes solving a real-world problem; integrates knowledge and skills accumulated over the entirety of the degree; first of a 2-part sequence.

## CS 492: Kaavish II (0+3)

Credit Hours: 0+3
Prerequisite: CS 491 – Kaavish I
Fulfills: CS Capstone

Self-directed final year project carried out under the supervision of a faculty member; emphasizes solving a real-world problem; integrates knowledge and skills accumulated over the entirety of the degree; second of a 2-part sequence.

## MATH 101: Calculus I

Credit Hours: 4
Prerequisites: None

Fulfills: Mandatory Math requirement for all DSSE students

Topics include an overview of functions and their behavior in terms of rates of change, average vs. instantaneous rates of change, the derivative and shortcuts to differentiation, optimization (finding relative extrema / critical points), related rates, area under a curve, Riemann sums and the definite integral, the general antiderivative, approximation of definite integrals, techniques of integration and improper integrals.

## MATH 102: Calculus II

Credit Hours: 3
Prerequisites: Math 101 Calculus I
Fulfills: Mandatory Math requirement for all DSSE students.

Topics include a look at finding volumes of revolution using a Riemann Sums approach to integration, an introduction to first-order differential equations and slope fields, parametric equations and graphs and finding area and arc length of parametric curves, polar coordinates, and polar functions with areas and arc length of polar curves, functions of severable variables, partial derivatives and the equation of a tangent plane to a surface, basic vector algebra with dot and cross product derivations, directional derivatives, optimization and the second derivative test for functions of two variables, optimization with Lagrange multipliers, integrating functions of several variables with double and triple integrals evaluated in Cartesian, cylindrical and spherical coordinates, parametrization of lines and curves in 3-space, vector fields, line integrals, and the fundamental theorem of calculus for line integrals.
properties.

## MATH 310: Probability and Statistics

Credit Hours: 3
Prerequisites: MATH 101 - Calculus I and MATH 102 - Calculus II
Fulfils: This course meets program requirements for EE & CS Majors & Quantitative Reasoning (QR) forms of thought for EE & CS Majors.

In the present world, we encounter situations where we have to make decisions on the basis of incomplete or imperfect information. The theory of probability helps provide a formal mechanism for understanding, quantifying, and dealing with uncertainty, which is ever present in our lives, pure science, or engineering applications. Simply, by uncertainty we mean the condition when outcomes or future are not completely determined or can be captured by a deterministic function; they depend on a number of factors and perhaps just on pure chance. A lot of our present-day technologies will not be possible without an understanding of how to make decisions in presence of uncertainty. These technologies include all forms of wireless communication, servers, speech processing systems, network systems and so many more. Equipping yourself with tools to deal with uncertainty will help you with whatever you wish to pursue in life.

This course will cover the foundations of probability, random variables and statistics, with a plethora of examples from electrical engineering, computer engineering, computer science, and everyday life. The course content can broadly be divided into three categories:

- Fundamentals of probability,
- Common probability models,
- Inferences & statistics.

## MATH 202: Engineering Mathematics

Credit Hours: 3
Prerequisites: MATH 101 - Calculus I and MATH 102 - Calculus II
Fulfils: Mandatory Math requirement for all DSSE students

Topics include: Vector Calculus (vector functions, line and surface integrals). Elementary methods for solving first order ODEs (direct integration and substitution) with geometric interpretation and classification, separable ODEs, method of integrating factors. Vector algebra (including matrix algebra,

eigenvalues and eigenvectors, quadric surfaces). Dynamical systems (linear systems of ODEs, stability and phase portraits of dynamical systems). Second, order ODEs – elementary methods including their classification, reduction of order techniques, linear second order ODEs with constant coefficients, and finding particular solutions. Orthogonal functions and Fourier series solutions (generalized and trigonometric methods), convergence in the mean and pointwise convergence, odd and even expansions, half-range expansions. Partial differential equations (PDEs) (wave, heat and Laplace equations), solutions using Fourier series and Laplace transforms, and Schor dinger equation.

### MATH 205: Linear Algebra

Credit Hours: 3
Prerequisites: None
Fulfils: Mandatory Math requirement for all DSSE students

Topics covered: A brief revision of vector algebra including lines and planes in 3D and matrices, Determinants, Symmetric matrices, and quadratic forms; Elementary row and column operations of a matrix; Systems of linear equations and their solutions, existence, and uniqueness of solutions; Vector spaces; Inner products and ortho-normalization; Orthogonal transformations and rotations; Linear transformations, orthogonality, QR factorization, Hermitian and Unitary transformations; Least squares analysis and approximations; Singular value decomposition; Direct sum decomposition; and Caley-Hamilton Theorem.

### PHY 101: Mechanics and Thermodynamics

Credit Hours: 3+0
Prerequisites: None
Fulfills: Natural Science Requirement – Mandatory for EE

Mechanics and Thermodynamics Topics include Units and physical quantities, vectors, motion in 1-dimension, motion in more than 1-dimension, Newton's laws of motion and their applications, work and energy, potential energy and conservation law of energy, momentum and impulse, rotation of rigid bodies, dynamics of rigid bodies, gravitation, thermal properties of matter, laws of thermodynamics.

### PHY 102: Electricity and Magnetism

Credit Hours: 3+0
Prerequisites: PHY 101
Fulfills: Physics Minor Foundational Course

Electricity & Magnetism Topics include Electromagnetism and electrostatics, electric charge, Coulomb's law, electric field, Gauss's law, electrostatic potential, magnetic fields, Biot-Savart law and Ampere's law, magnetic materials, time-varying fields and Faraday's law of induction, Hall effect, displacement current, and Maxwell's equations.

## Professional Practices Category Courses:

The students are required to enroll in either one of the following courses falling under the Professional Practices category:

### MGMT 304: Fundamentals of Intellectual Property

Course Prerequisites: None
Credit hours: 3+0

A primary purpose of this course is to raise awareness of Intellectual Property (IP) amongst students and to introduce the topic of IP, associated law, and some of its primary branches, to a non-legal (e.g. STEM, social sciences, design, liberal arts) audience so that they may effectively navigate through the landscape of various intellectual property regimes and related family of (legal) rights (IPR). Whilst these rights are rooted in law, intellectual property education has branches which touch many areas of academic research and commercial activity, including: economics, finance, taxation, human rights, ethics, education, governance and management. Studying intellectual property in a non-law curriculum can be seen as an 'opportunity' to

engage with a vital topic that links commercial, legal and technical disciplines. Another important purpose of this course is to introduce students to the increasingly important area of IP management (and IP strategy). IP and intangible assets are driven by investments in R&D, advertising and marketing, education and training, management information systems, organizational structure, and so on. The development of such assets can involve invention or some other creative step, as well as innovation. The investments and the activities involved are all inherently risky. Thus, understanding the management of IP and intangible assets requires inputs from a variety of disciplines, including economics, law, accounting and finance, management, and so on. An exposure to some key tactics on the strategic management of IP supplemented with relevant IP management case studies can be of immense value in todays and tomorrow's expanding ecosystem.

### MGMT 320: Principles of Management

Course Prerequisites: None
Credit Hours: 3+0

The course on Principles of Management for Tech Professionals introduces management as a discipline and process to tech professionals. This course includes evolution and scope of management, decision-making, planning, strategy, organizing, staffing, leading, control, change, and the importance of management in the global environment and ethical considerations of management decisions. Hence, the course provides a framework that will enhance a person's effectiveness in the business.

### MGMT 321: Engineering Project Management

Course Prerequisites: None
Credit Hours: 3+0

Through using textbook, discussions, assignments and real-world examples, the engineering professionals will learn how to identify, define, plan, execute, monitor, control, and close projects. They will build project components, organize work efficiently, effectively and help them to control changes. The students will use tools to build works schedules, allocate resources and manage cost of any project. This will help them to get a hands-on training of using project management tools for the smooth flow of various stages of project that is the need of time and most demanded skill by the employers all around the world.

### MGMT 322: Operations Management

Course Prerequisites: None
Credit Hours: 3+0

The course aims to provide an understanding to identify, define, plan, execute, monitor, control, optimize and improve operations and processes in both manufacturing and service industries. For many different types of operations either in the tangible goods industry or the intangible service industry, this course aims to familiarize students with the major operational issues that challenge entrepreneurs and managers and provide them with the basic language, concepts, insights, and analytical tools to deal with these issues.

### MGMT 323: Supply Chain Management

Course Prerequisites: None
Credit Hours: 3+0

The course aims to provide an understanding of fundamental concepts of supply chain management. All functional areas of supply chain management are explored in an integrated view of procurement, manufacturing and operations management, transportation and logistics, inventory and warehousing, demand planning, scheduling, network design, collaboration, and performance measurement. Topics may also cover supply chain financial metrics, strategy, and risk management for demand-driven value networks.

# LIST OF ELECTIVES:

Below is the proposed list of elective courses offered by the CS Major. These elective courses may be subject to change.

## Fall 2019

CS 262 – Computational Social Science

CS 316 – Introduction to Deep Learning

CS 316L - Introduction to Deep Learning Lab

CS 351 – Artificial Intelligence

CS 370 – Web and Mobile Development

CS 400 – CS Senior Seminar

CS 440 – Computer Graphics

CS 340/MATH 321 – Geo Modelling & Analysis

## Spring 2020

CS 326 – Mathematics of Machine Learning

CS 342 – Intro to Game Development

CS 342L – Intro to Game Development Lab

CS 363 – Networks & Collective Behavior

CS 451 – Computational Intelligence

CS 314/PHY 300 – Quantum Computing

EE 371/CS 300 – Computer Architecture

EE 371L/CS 300L – Computer Architecture Lab

## Fall 2020

CS 351 – Artificial Intelligence

CS 370 – Web and Mobile Development

CS 370 Lab – Web and Mobile Development Lab

CS 400 – CS Senior Seminar

CS 432 – GPU Accelerated Computing

CS 440 – Computer Graphics

CS 457 – Data Science

CS/SDP 262 – Computational Social Science

## Spring 2021

CS 363 – Networks & Collective Behavior

CS 375 – Parallel Programming

CS 424 – Joy of Theoretical Computer Science

CS 451 – Computational Intelligence

CS 326/MATH 320 – Mathematics of Machine Learning

CS 314/PHY 300 – Quantum Computing

EE 371/CS 330 – Computer Architecture

EE 371L/CS 330L – Computer Architecture Lab

## Fall 2021

CS 316 – Introduction to Deep Learning

CS 316L - Introduction to Deep Learning Lab

CS 324 – Advanced Programming in Java

CS 351 – Artificial Intelligence

CS 370 – Web and Mobile Development

CS 440 – Computer Graphics

CS 446 – Applied Digital Image Processing

CS 314/PHY 300 – Quantum Computing

CS/SDP 262 – Computational Social Science

## Spring 2022

CS 363 – Networks & Collective Behavior

CS 371 – Software Security

CS 400 – CS Senior Seminar

CS 432 – GPU Accelerated Computing

CS 451 – Computational Intelligence

CS 457 – Data Science

EE 371/CS 300 – Computer Architecture

EE 371L/CS 300L – Computer Architecture Lab

## Fall 2022

CS 316 – Introduction to Deep Learning

CS 316L - Introduction to Deep Learning Lab

CS 351 – Artificial Intelligence

CS 370 – Web and Mobile Development

CS 421 – Compiler Design & Construction

CS 440 – Computer Graphics

CS 446 – Applied Digital Image Processing

CS 314/PHY 300 – Quantum Computing

CS 361/SDP 352 – Social Network Analysis

# GRADUATING REQUIREMENTS:

| Course Category | No. of Courses+ |
|---|---|
| **University Requirements** | |
| Habib Liberal Core | 10 |
| **Natural Science and Mathematics Requirement** | |
| Natural Science | 02 |
| Mathematics | 05 |
| **Computer Science Requirements** | |
| CS Foundation | 03 |
| CS Kernel | 08 |
| CS Electives | 05 |
| Final Year Capstone Project (*Kaavish*) | 02 |
| **Other Requirements** | |
| *Khidmat* (field practice) | 01 |
| Digital Logic and Design | 01 |
| CS Freshman Seminar | 01 |
| Professional Practice | 01 |
| Free Electives | 05 |
| **Overall** | **44** |

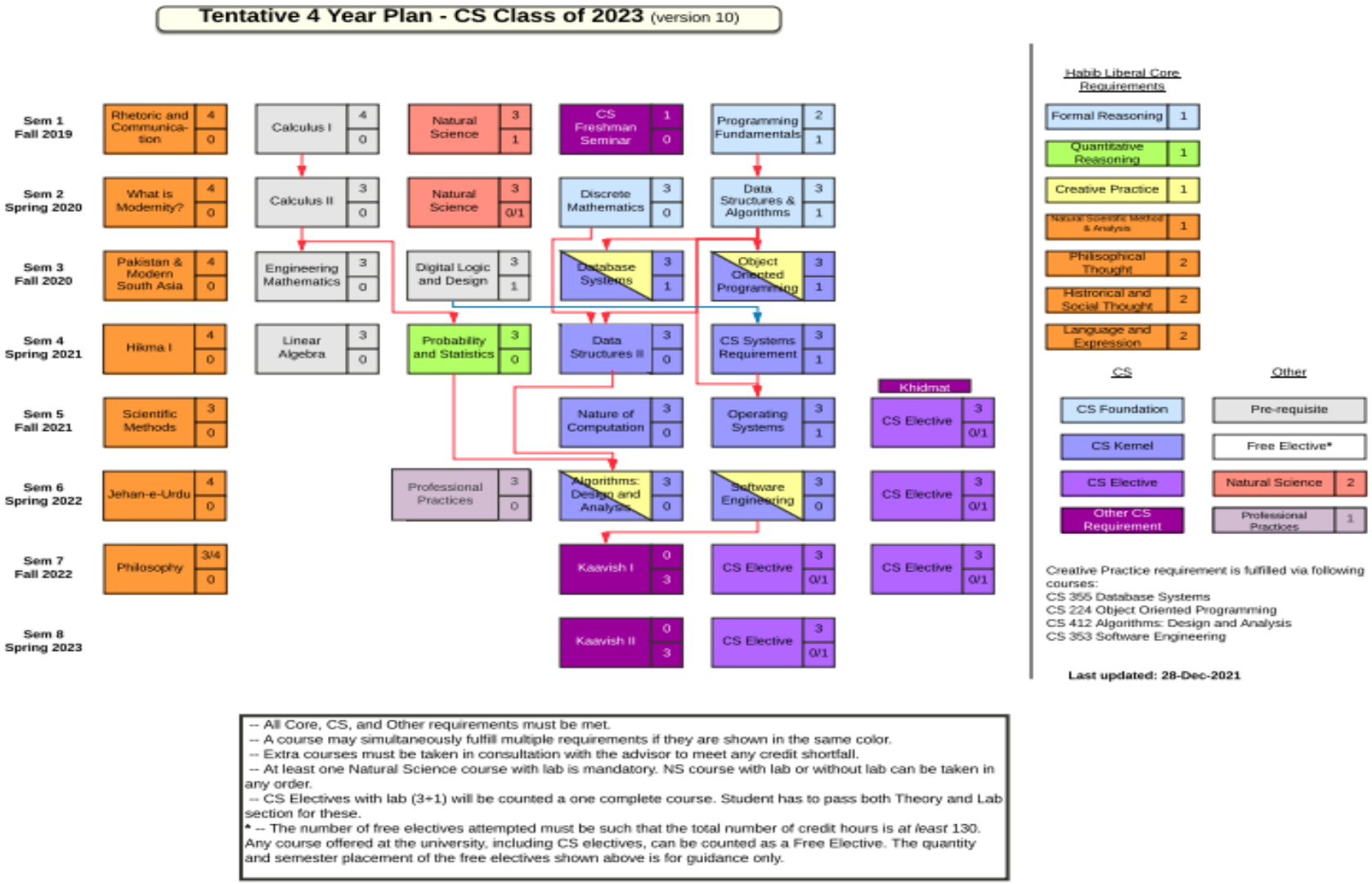
Graduating requirement requires:

1. Minimum 130 credit hours completion.
2. Minimum 2.33 CGPA for degree clearance.
3. For CS 101, the University's first semester policy applies to only those students attending it in their first semester. Otherwise, the unified grade base applies.
4. CS Foundation and Kernel courses must be cleared with an earned grade of C+ or higher unless some other grading scheme, e.g., first-semester policy, applies.

**Note:**

CS Senior Seminar doesn't fulfill the CS - Elective requirement for CS Minor or CS Major.

# 4-YEAR GRID:




-- All Core, CS, and Other requirements must be met.
-- A course may simultaneously fulfill multiple requirements if they are shown in the same color.
-- Extra courses must be taken in consultation with the advisor to meet any credit shortfall.
-- At least one Natural Science course with lab is mandatory. NS course with lab or without lab can be taken in any order.
-- CS Electives with lab (3+1) will be counted a one complete course. Student has to pass both Theory and Lab section for these.
* -- The number of free electives attempted must be such that the total number of credit hours is *at least* 130. Any course offered at the university, including CS electives, can be counted as a Free Elective. The quantity and semester placement of the free electives shown above is for guidance only.