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Programme Structure for BS Computer Science

The Bachelor of Science in Computer Science is designed to provide students with a solid foundation in the field of computer science, equipping them with the knowledge and skills necessary to succeed in both industry and academic environments. The program spans over a period of 4 years, divided into 8 semesters, with each academic year consisting of two semesters—Fall and Spring. To successfully graduate from this program, students must complete a minimum of 130 credit hours.

Programme Duration:

- Total Duration: 4 years

- Semesters: 8 semesters (2 semesters per year: Fall and Spring)

Programme Eligibility:

To be eligible for admission into the BS Computer Science program, candidates must meet the following criteria:

- Educational Background:

  - FSc in Pre-Medical, Pre-Engineering, or Intermediate in Computer Science (ICS)

  - Alternatively, FA with Mathematics or an equivalent qualification is also acceptable.

- Minimum Marks Requirement: Students are required to have achieved at least 50% marks in their qualifying examinations.

Programme Structure Overview:

The structure of the BS Computer Science program is formulated in accordance with the 2017 guidelines provided by the Higher Education Commission (HEC). The credit hour distribution across different course categories ensures that students receive comprehensive exposure to core computer science concepts, supporting courses, and electives, as well as essential general education subjects.

The distribution of credit hours is as follows:

1. Computing Courses:

  These courses form the core of the program and include subjects that provide essential knowledge in computing principles, programming, algorithms, and more.

  - Total Computing Credit Hours: 51

  - Core Courses: 39 credit hours

  - Mathematics and Science Foundation Courses: 12 credit hours

2. Computer Science Courses:

This category focuses specifically on computer science topics that build on the foundation provided by the computing courses. Students will cover topics like operating systems, computer networks, and databases.

  - Total Computer Science Credit Hours: 51

  - Core Courses: 24 credit hours

  - Supporting Courses: 9 credit hours

  - Elective Courses: 18 credit hours

3. General Education Courses:

  General education courses are included to develop well-rounded graduates with strong communication skills and a broader understanding of social, cultural, and business topics. These courses cover areas such as English composition, technical writing, and Pakistan Studies.

  - Total General Education Credit Hours: 19

4. University Elective Courses:

  These courses provide students with the flexibility to choose subjects outside of the core and general education curriculum, offering an opportunity to explore areas of personal interest or market demand.

  - Total University Elective Credit Hours: 12

5. Non-Credit Courses:

  These courses are offered to students without affecting their total credit hour count. Such courses might be useful for students who need extra knowledge in specific areas.

  - Total Non-Credit Hours: 0

The overall credit hour requirement for the BS Computer Science program is 133 credit hours.

 Breakdown of Core Courses

The core courses within the computing and computer science categories are designed to provide both theoretical knowledge and practical experience in essential subjects. Below is a breakdown of the major core courses included in the program:

1. Computing Core Courses:

  - Programming Fundamentals (CS-102): 4 credit hours (3 hours of theory + 1 hour of lab)

  - Object-Oriented Programming (CS-151): 4 credit hours (3+1)

  - Data Structures and Algorithms (CS-201): 4 credit hours (3+1)

  - Discrete Structures (CS-152): 3 credit hours (3+0)

  - Operating Systems (CS-301): 4 credit hours (3+1)

  - Database Systems (CS-251): 4 credit hours (3+1)

- Software Engineering (SE-302): 3 credit hours (3+0)

- Computer Networks (CS-352): 4 credit hours (3+1)

- Human-Computer Interaction (CS-452): 3 credit hours (3+0)

- Final Year Project I (CS-404): 3 credit hours (0+3)

- Final Year Project II (CS-404): 3 credit hours (0+3)

These courses focus on building foundational knowledge in programming, algorithms, software engineering, and system-level topics.

2. Computer Science Supporting Courses:

In addition to core courses, students will take supporting courses to deepen their understanding of mathematics and theoretical concepts.

- Differential Equations (MATH-201): 3 credit hours (3+0)

- Multi-variate Calculus (MATH-XXX): 3 credit hours (3+0)

- Graph Theory (CS-304): 3 credit hours (3+0)

- Theory of Programming Languages (CS-305): 3 credit hours (3+0)

- Numerical Computing (MATH-302): 3 credit hours (3+0)

General Education Courses

General education is an important part of the program, ensuring that students develop strong communication skills and gain a broader perspective on social and professional issues. The general education courses include:

- English Composition and Comprehension (ENG-101): 3 credit hours (3+0)

- Communication and Presentation Skills (ENG-151): 3 credit hours (3+0)

- Technical and Business Writing (ENG-351): 3 credit hours (3+0)

- Islamic Studies (ISL-101): 2 credit hours (2+0)

- Pakistan Studies (PS-151): 2 credit hours (2+0)

- Professional Practices (MGT-201): 3 credit hours (3+0)

- Introduction to Information and Communication Technologies (CS-101): 3 credit hours (2+1)

Elective Courses

Students are offered a wide range of elective courses in their final years. These electives allow students to specialize in areas such as web technologies, cloud computing, artificial intelligence, and data mining, among others. The selection of electives depends on the expertise of the faculty and the current demands of the job market.

The BS Computer Science program at the University of Swat is carefully designed to equip students with both theoretical knowledge and practical skills. With a balance of core computer science subjects, supporting mathematics courses, general education, and a broad range of electives, the program prepares graduates for the challenges of the modern IT industry and academic fields.

General Education Courses

The BS Computer Science program at the University of Swat includes a comprehensive selection of General Education Courses. These courses are designed to equip students with essential skills beyond the technical realm, emphasizing communication, professional practices, and cultural understanding. Here's a detailed explanation of these courses:

1. ENG-101: English Composition and Comprehension (3 Credit Hours)

  - Course Structure: 3 hours of theory.

  - Overview: This course focuses on developing students' ability to compose clear and grammatically correct sentences, paragraphs, and essays. Students will practice critical reading and writing skills, which are essential for effective communication in both academic and professional settings.

2. ENG-151: Communication and Presentation Skills (3 Credit Hours)

  - Course Structure: 3 hours of theory.

  - Overview: This course is designed to enhance students' oral communication and presentation skills. Students will learn techniques for delivering effective presentations, managing public speaking anxiety, and structuring their talks to engage audiences. The course also covers the use of visual aids in presentations.

3. ENG-351: Technical and Business Writing (3 Credit Hours)

  - Course Structure: 3 hours of theory.

  - Overview: This course is crucial for students to learn how to write clear and concise business and technical documents. Topics include report writing, email etiquette, and the structure of formal business communication. Students will also learn to produce technical documents like proposals, manuals, and project reports.

4. ISL-101: Islamic Studies (2 Credit Hours)

  - Course Structure: 2 hours of theory.

  - Overview: This course provides students with an understanding of the basic principles of Islam, including its history, teachings, and ethical dimensions. The aim is to help students integrate these principles into their personal and professional lives, promoting a deeper understanding of their cultural and religious heritage.

5. PS-151: Pakistan Studies (2 Credit Hours)

  - Course Structure: 2 hours of theory.

- Overview: This course covers the historical, political, and cultural aspects of Pakistan. Topics include the country's struggle for independence, its constitutional development, and the role of various leaders in shaping its history. The course also covers the geopolitical significance of Pakistan in the modern world.

6. MGT-201: Professional Practices (3 Credit Hours)

- Course Structure: 3 hours of theory.

- Overview: This course introduces students to professional ethics and practices in the workplace. Topics include ethical decision-making, professional behavior, leadership, and teamwork. Students will learn the importance of professionalism in a globalized workplace and how to handle ethical dilemmas.

7. CS-101: Introduction to Information and Communication Technologies (3 Credit Hours: 2 Theory + 1 Lab)

- Course Structure: 2 hours of theory and 1 hour of lab work.

- Overview: This foundational course introduces students to the basics of information and communication technologies (ICT). It covers the history and development of computing, basic hardware and software concepts, and an introduction to networking and the internet. The course also includes practical labs where students will get hands-on experience with common ICT tools.

Core Computer Science Courses

The core computer science courses form the backbone of the BS Computer Science program, providing students with both theoretical knowledge and practical experience in various areas of computer science. Below is a detailed description of these courses:

1. CS-303: Compiler Construction (3 Credit Hours)

- Course Structure: 3 hours of theory.

- Overview: This course teaches students the principles behind designing and constructing compilers. Topics include lexical analysis, syntax analysis, semantic analysis, code generation, and optimization techniques. Students will learn how a high-level language is translated into machine code.

2. CS-203: Computer Organization & Assembly Language (4 Credit Hours: 3 Theory + 1 Lab)

- Course Structure: 3 hours of theory and 1 hour of lab.

- Overview: This course provides an understanding of the internal structure of computers and their components. Students will learn assembly language programming and how different hardware components, such as the CPU and memory, interact with software.

3. CS-202: Digital Logic Design (4 Credit Hours: 3 Theory + 1 Lab)

- Course Structure: 3 hours of theory and 1 hour of lab.

- Overview: Students are introduced to digital circuits and systems, which form the basis of modern computing hardware. Topics include Boolean algebra, logic gates, flip-flops, counters, and memory systems. Practical labs will involve designing and testing digital circuits.

4. CS-252: Design and Analysis of Algorithms (3 Credit Hours: 2 Theory + 1 Lab)

   - Course Structure: 2 hours of theory and 1 hour of lab.

   - Overview: This course covers the design, analysis, and optimization of algorithms. Students will learn techniques like divide-and-conquer, dynamic programming, and greedy algorithms, along with a study of their computational complexity and efficiency.

5. CS-403: Parallel & Distributed Computing (3 Credit Hours)

   - Course Structure: 3 hours of theory.

   - Overview: This course introduces students to parallel and distributed systems, emphasizing the principles and practices of parallel programming. Topics include synchronization, concurrency, and distributed algorithms.

6. CS-351: Artificial Intelligence (4 Credit Hours: 3 Theory + 1 Lab)

   - Course Structure: 3 hours of theory and 1 hour of lab.

   - Overview: This course covers the fundamental concepts of artificial intelligence (AI), including search algorithms, knowledge representation, reasoning, and machine learning. Students will also engage in hands-on projects to implement basic AI models.

7. CS-253: Theory of Automata (3 Credit Hours)

   - Course Structure: 3 hours of theory.

   - Overview: This theoretical course covers formal languages and automata theory, which are foundational topics for computer science. Students will study finite automata, regular expressions, context-free grammars, and Turing machines.

Mathematics and Science Foundation Courses

The foundation courses in mathematics and science support the technical aspects of computer science and help students develop the necessary analytical skills for problem-solving.

1. MATH-101: Calculus and Analytical Geometry (3 Credit Hours)

   - Course Structure: 3 hours of theory.

   - Overview: This course covers the fundamentals of calculus, including limits, derivatives, integrals, and their applications. Students will also explore analytical geometry concepts such as conic sections.

2. STAT-151: Probability and Statistics (3 Credit Hours)

   - Course Structure: 3 hours of theory.

   - Overview: This course introduces students to the basics of probability theory and statistical analysis. Topics include probability distributions, hypothesis testing, regression, and data analysis.

3. MTH-251: Linear Algebra (3 Credit Hours)

- Course Structure: 3 hours of theory.

  - Overview: Linear algebra is crucial for various fields in computer science, including machine learning, computer graphics, and optimization. This course covers matrix theory, vector spaces, linear transformations, and eigenvalues.

4. PHY-101: Applied Physics (3 Credit Hours)

  - Course Structure: 3 hours of theory.

  - Overview: Applied physics introduces students to the fundamental principles of physics, with a focus on applications in computing and electronics. Topics include mechanics, electromagnetism, and wave theory.

 Computer Science Elective Courses

The elective courses allow students to specialize in specific areas of computer science based on their interests and market demands. Below are detailed explanations of a few key electives:

1. CS-353: Modern Programming Languages (3 Credit Hours: 2 Theory + 1 Lab)

  - Overview: This course introduces students to modern programming languages and paradigms. Topics include object-oriented, functional, and concurrent programming, along with hands-on experience in newer languages.

2. IT-451: Web Technologies (3 Credit Hours: 2 Theory + 1 Lab)

  - Overview: This course covers web development technologies, including front-end and back-end development, web frameworks, and tools. Students will learn to create dynamic, interactive websites.

3. CS-401: Visual Programming (3 Credit Hours: 2 Theory + 1 Lab)

  - Overview: This course focuses on developing software with graphical user interfaces (GUIs). Students will learn to create interactive, visually appealing applications using modern visual programming environments.

4. IT-455: Cloud Computing (3 Credit Hours)

  - Overview: This course covers the principles of cloud computing, including cloud infrastructure, services, and deployment models. Students will gain hands-on experience with cloud platforms.

5. CS-354: Introduction to Soft Computing (3 Credit Hours)

  - Overview: This course covers soft computing techniques, such as fuzzy logic, genetic algorithms, and neural networks, which are useful for solving complex real-world problems where traditional approaches may not suffice. Students will learn how to apply these techniques to optimize and model systems with uncertainty.

6. CS-454: Real-Time Systems (3 Credit Hours)

- Overview: This course focuses on the design and development of systems that must meet strict timing constraints. Topics include real-time scheduling, task management, and system reliability. Students will explore applications of real-time systems in fields like embedded systems and robotics.

7. CS-355: Data Warehousing (3 Credit Hours)

- Overview: This course teaches the principles and practices of data warehousing, including data modeling, ETL (Extract, Transform, Load) processes, and query optimization. Students will learn how to design, implement, and manage large-scale data warehouses for efficient decision support.

8. CS-455: Data Mining (3 Credit Hours)

- Overview: This course focuses on data mining techniques used to discover patterns and insights from large datasets. Topics include classification, clustering, association rule mining, and anomaly detection. Students will apply these techniques to real-world datasets.

9. CS-456: Data Encryption and Security (3 Credit Hours)

- Overview: This course explores techniques for ensuring data confidentiality, integrity, and security. Topics include encryption algorithms, cryptographic protocols, and security vulnerabilities. Students will gain hands-on experience in implementing security solutions.

10. CS-457: Computer Graphics (3 Credit Hours: 2 Theory + 1 Lab)

- Overview: This course introduces students to the principles and techniques used in computer graphics. Topics include 2D and 3D rendering, transformations, and graphical algorithms. Students will learn to develop graphical applications using modern graphics APIs.

11. CS-458: Big Data Analytics (3 Credit Hours)

- Overview: This course covers the principles and technologies behind big data analytics. Students will explore the use of distributed systems and parallel processing frameworks like Hadoop and Spark to analyze large datasets. Topics include data processing, visualization, and machine learning.

12. CS-360: Game Application Development (3 Credit Hours: 2 Theory + 1 Lab)

- Overview: This course provides students with the skills needed to design and develop video games. Topics include game mechanics, physics engines, artificial intelligence in games, and graphics rendering. Students will build a complete game as part of the coursework.

13. CS-459: Natural Language Processing (3 Credit Hours)

- Overview: This course introduces students to natural language processing (NLP), which involves enabling computers to understand and generate human language. Topics include language modeling, text classification, machine translation, and sentiment analysis. Students will implement basic NLP models.

14. CS-460: Semantic Web (3 Credit Hours)

- Overview: This course covers the principles behind the Semantic Web, a web of data that can be processed by machines. Topics include ontologies, RDF (Resource Description Framework), and SPARQL. Students will learn how to build and query semantic web applications.

15. CS-362: System Programming (3 Credit Hours: 2 Theory + 1 Lab)

- Overview: This course focuses on low-level programming, particularly interacting with operating systems and hardware. Topics include process management, memory management, file systems, and inter-process communication. Students will gain hands-on experience in system-level programming.

16. SE-357: Topics in Software Engineering (3 Credit Hours)

- Overview: This course covers advanced topics in software engineering, such as design patterns, software architectures, and software quality assurance. The course may also include emerging trends in software development methodologies.

University Elective Courses

The university elective courses allow students to explore topics outside their core computer science curriculum. These courses provide a broader perspective and enhance students' understanding of various disciplines, contributing to their overall intellectual development.

1. MGT-151: Principles of Accounting (3 Credit Hours)

- Overview: This course introduces students to basic accounting principles, including financial statements, bookkeeping, and accounting cycles. It is particularly useful for students interested in entrepreneurship or working in management roles within the tech industry.

2. MGT-251: Organizational Behavior (3 Credit Hours)

- Overview: Organizational behavior studies how individuals and groups act within organizations. This course covers motivation theories, leadership styles, and group dynamics. It is essential for students who wish to understand how to manage teams and foster a positive work environment.

3. PSY-401: Principles of Psychology (3 Credit Hours)

- Overview: This course provides a basic understanding of human psychology, focusing on cognitive processes, behavior, and emotions. Students will learn how psychological principles can be applied in areas such as marketing, user experience design, and human-computer interaction.

4. MGT-451: Entrepreneurship (3 Credit Hours)

- Overview: This course explores the entrepreneurial process, from ideation to creating a sustainable business model. Students will learn about business planning, funding, and scaling a venture. This course is valuable for students interested in starting their own businesses or leading innovation within an organization.

Non-Credit Courses

The non-credit courses in the BS Computer Science program offer students additional learning opportunities without affecting their total credit hour count. These courses may be recommended for students who require a stronger foundation in specific areas.

1. MTH-103: Mathematics I (3 Credit Hours)

   - Overview: This course is aimed at students who need to strengthen their mathematical skills, covering topics such as algebra, trigonometry, and basic calculus. Although non-credit, it provides a vital foundation for success in more advanced mathematics courses.

2. MATH-154: Mathematics II (3 Credit Hours)

   - Overview: A continuation of Mathematics I, this course further develops students' understanding of mathematical concepts, with a focus on calculus and its applications. It is particularly useful for students from non-technical backgrounds, such as those with a pre-medical educational history.

Semester-Wise Course Breakdown

Semester I:

- CS-101: Introduction to Information and Communication Technologies – 3 (2 Theory + 1 Lab)

- CS-102: Programming Fundamentals – 4 (3 Theory + 1 Lab)

- MATH-101: Calculus and Analytical Geometry – 3 (3 Theory)

- ISL-151: Islamic Studies – 2 (2 Theory)

- ENG-101: English Composition and Comprehension – 3 (3 Theory)

- PHY-101: Applied Physics – 3 (3 Theory)

- MATH-103: Mathematics-I (Non-Credit Course for Pre-Medical Students) – 3 (3 Theory)

- Total Semester Credit Hours: 18 (16 Theory + 2 Lab)

Semester II:

- CS-151: Object-Oriented Programming – 4 (3 Theory + 1 Lab)

- CS-152: Discrete Structures – 3 (3 Theory)

- ENG-151: Communication and Presentation Skills – 3 (3 Theory)

- STAT-151: Probability and Statistics – 3 (3 Theory)

- PS-151: Pakistan Studies – 2 (2 Theory)

- MGT-151: Principles of Accounting – 3 (3 Theory)

- MATH-154: Mathematics-II (Non-Credit Course for Pre-Medical Students) – 3 (3 Theory)

- Total Semester Credit Hours: 18 (17 Theory + 1 Lab)

Semester III:

- CS-201: Data Structures and Algorithms – 4 (3 Theory + 1 Lab)

- CS-203: Computer Organization and Assembly Language – 4 (3 Theory + 1 Lab)

- CS-202: Digital Logic Design – 4 (3 Theory + 1 Lab)

- MGT-201: Professional Practices – 3 (3 Theory)

- MTH-201: Differential Equations – 3 (3 Theory)

- Total Semester Credit Hours: 18 (15 Theory + 3 Lab)

Semester IV:

- CS-252: Design and Analysis of Algorithms – 3 (2 Theory + 1 Lab)

- CS-253: Theory of Automata – 3 (3 Theory)

- CS-251: Database Systems – 4 (3 Theory + 1 Lab)

- MATH-251: Linear Algebra – 3 (3 Theory)

- MGT-251: Organizational Behavior – 3 (3 Theory)

- Total Semester Credit Hours: 16 (14 Theory + 2 Lab)

Semester V:

- CS-303: Compiler Construction – 3 (3 Theory)

- CS-304: Graph Theory – 3 (3 Theory)

- CS-301: Operating Systems – 4 (3 Theory + 1 Lab)

- CS-302: Software Engineering – 3 (3 Theory)

- MATH-302: Numerical Computing – 3 (2 Theory + 1 Lab)

- Total Semester Credit Hours: 16 (14 Theory + 2 Lab)

Semester VI:

- CS-351: Artificial Intelligence – 4 (3 Theory + 1 Lab)

- CS-352: Computer Networks – 4 (3 Theory + 1 Lab)

- CS Elective-1 – 3 (2 Theory + 1 Lab)

- CS Elective-2 – 3 (3 Theory)

- ENG-351: Technical and Business Writing – 3 (3 Theory)

- Total Semester Credit Hours: 17 (14 Theory + 3 Lab)

Semester VII:

- CS Elective-3 – 3 (2 Theory + 1 Lab)

- CS Elective-4 – 3 (3 Theory)

- PSY-401: Principles of Psychology – 3 (3 Theory)

- CS-403: Parallel and Distributed Computing – 3 (3 Theory)

- CS-404: Final Year Project I – 3 (0 Theory + 3 Lab)

- Total Semester Credit Hours: 15 (11 Theory + 4 Lab)

Semester VIII:

- CS Elective-5 – 3 (3 Theory)

- MGT-451: Entrepreneurship – 3 (3 Theory)

- CS Elective-6 – 3 (3 Theory)

- CS-452: Human-Computer Interaction – 3 (3 Theory)

- CS-404: Final Year Project II – 3 (0 Theory + 3 Lab)

- Total Semester Credit Hours: 15 (12 Theory + 3 Lab)

This comprehensive breakdown ensures clarity and organization, making it easy for models to parse, understand, and retrieve relevant information. The structured and detailed text is optimized for text generation and retrieval tasks.