BS Computer Science

■ Program Educational Objectives (PEOs)

The BS(CS) program aims to produce leading professionals who will:

(i) Contribute competently in the computing industry by applying requisite technical skills.

(ii) Demonstrate advancement in computing profession by enhancing their knowledge and skills.

(iii) Demonstrate ethical values and contribute positively towards the society.

■ Program Learning Outcomes (PLOs)

At the time of graduation, the graduates of BS(CS) program will possess the following attributes

(i) **Academic Education:** To prepare graduates as computing professionals.

(ii) **Knowledge for Solving Computing Problems:** Apply computer science theory and software development fundamentals to produce computing-based solutions.

(iii) **Problem Analysis:** Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

(iv) **Design/Development of Solutions:** Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the problem's discipline.

(v) **Modern Tool Usage:** Create, select , adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

(vi) **Individual and Team Work:** Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

(vii) **Communication:** Communicate effectively, in a variety of professional contexts.

(viii) **Computing Professionalism and Society:** Recognize professional responsibilities and make informed judgments in computing practice based on legal principles.

(ix) **Ethics:** Understand and commit to professional ethics, responsibilities and norms of professional computing practice.

(x) **Lifelong Learning:** Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

■ Admission Requirements

(i) Higher Secondary School Certificate or equivalent securing at least 50% marks in aggregate with Mathematics.

(ii) CUST Admission Test/HEC Approved Test

■ Degree Requirements

Each candidate for the BS Computer Science degree is required to successfully earn 130 credit hours (Cr. Hrs.) as per the following detail:

	Area	Cr. Hrs.
(a)	Core Courses	
	• Computing Core	33
	• Computer Science Core	24
(b)	Supporting Courses	
	• Mathematics and Science Foundation	12
	• Computer Science Supporting	09
(c)	General Education Courses	19
(d)	University Electives	12
(e)	Computer Science Electives	15
(f)	Design Project	06
(g)	Internship	00
(h)	Community Service	00
	Total	**130**

■ Core Courses (57 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Introduction to Programming Lab	CS1131	1
Introduction to Programming	CS1133	3
Object Oriented Programming Lab	CS1141	1
Object Oriented Programming	CS1143	3
Data Structures Lab	CS2141	1
Data Structures	CS2143	3
Discrete Structures	CS2053	3
Operating Systems Lab	CS3411	1
Operating Systems	CS3413	3
Introduction to Database Systems Lab	CS2311	1
Introduction to Database Systems	CS2313	3
Software Engineering-I	CS2223	3
Computer Networks Lab	CS3771	1
Computer Networks	CS3773	3

Introduction to Information Security and Forensics	CS3713	3
Compiler Construction	CS4623	3
Computer Organization and Assembly Language Lab	CS2521	1
Computer Organization and Assembly Language	CS2523	3
Digital Logic Design Lab	CS2511	1
Digital Logic Design	CS2513	3
Design and Analysis of Algorithms	CS3163	3
Parallel and Distributed Computing	CS3433	3
Artificial Intelligence Lab	CS4811	1
Artificial Intelligence	CS4813	3
Theory of Automata and Formal Languages	CS3613	3

■ Mathematics and Science Foundation Courses (12 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Calculus and Analytical Geometry	MTCS1013	3
Probability and Statistics	MTCS3063	3
Linear Algebra	MTCS1033	3
Applied Physics	PHCS1013	3

■ Computer Science Supporting Courses (09 Cr. Hrs.)

(Any 3 from following list) Coverage of relevant pre-requisite must be ensured while offering any of the following courses from this category.

Course Title	Code	Cr. Hrs.
Applied Differential Equations	MTCS2043	3
Multi-variate Calculus	MTCS1053	3
Graph Algorithms	CS3283	3
Theory of Programming Languages	CS3833	3
Numerical Computing	CS3073	3

■ General Education Courses (19 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
English-I	HMCS1013	3
Technical Report Writing	HMCS2033	3
English-II	HMCS1023	3
Professional Ethics and Legal Issues	HMCS2013	3
Personal Management and Grooming	HMCS1033	3
Pakistan Studies	HMCS1002	2
Islamic Studies / Ethics	HMCS1012	2

■ University Elective Courses (12 Cr. Hrs.)

(Any 4 from following list) Not limited to the list below, University may add more courses.

Course Title	Code	Cr. Hrs.
Introduction to Psychology	HMCS2053	3
Introduction to Sociology	HMCS2063	3
Financial Accounting-I	ACCS3003	3
Introduction to Management	MGCS1003	3
Project Management	MICS4193	3
Supply Chain Management	MICS4183	3

Introduction to Chinese Language	HMCS2213	3
Introduction to French Language	HMCS2223	3

■ Computer Science Electives Courses (15 Cr. Hrs.)

A student has to take at least five courses in a particular stream to get a specialization to be mentioned on his/her transcript

a–ICT Specialization

Course Title	Code	Cr. Hrs.
Network Programming	CS3743	3
Introduction to Data Warehousing	CS4333	3
Web Frameworks	CS4463	3
Advanced Mobile Application Development	CS4553	3
Advanced Networking	CS4723	3
Wireless Networks and Mobile Systems Architecture	CS4763	3
Internet of the Things	CS4743	3
Wireless Sensor Network	CS4753	3

b–Information Security and Forensics

Course Title	Code	Cr. Hrs.
Database Security	CS3723	3
Network Security & Forensics	CS3833	3
Computer Forensics	CS4843	3
Data Security & Cryptography	CS3843	3
Web Security & Forensics	CS4863	3
Malware Analysis	CS4873	3
Wireless Security	CS4833	3
Penetration Testing	CS4893	3
Blockchain Technology	CS4573	3

c–CS General Electives

Course Title	Code	Cr. Hrs.
Operations Research	CS4633	3
Machine Learning	CS4613	3
Natural Language Processing	CS4893	3
Semantic Web	CS4323	3
Introduction to Data Science	CS4883	3
Introduction to Digital Image Processing	CS4563	3
Cloud Computing	CS4793	3
Human Computer Interaction	CS3273	3
Object Oriented Analysis and Design	CS3213	3
Mobile Application Development	CS4193	3
Enterprise Application Development	CS3183	3
Web Application Development	CS3193	3

■ Design Project (6 Cr. Hrs)

After the completion of 90 Cr. Hrs. the students are required to demonstrate their practical skills in the field of computer science by designing and implementing a design project worth 6 Cr. Hrs. The project shall be completed in two parts as given bellow:

Course Title	Code	Cr. Hrs.
Design Project (Part-I)	CS4912	2
Design Project (Part-II)	CS4924	4

■ Internship (CS4100)

It is mandatory for every student to participate in a 6-8 weeks summer internship program following their 6^{th} semester or after the completion of 90 Cr. Hrs.

■ Community Service (VIS4000)

Each student is required to complete 65 hours community work, usually after 4^{th} semester which would be a prerequisite to clear the student for the award of degree.

■ CGPA Requirement

A student is required to earn a minimum 2.00/4.00 CGPA on the completion of his/her degree requirements.

■ Program Duration

This is a four years degree program comprising of 8 semesters with a minimum of 133 Cr. Hrs. There will be a Fall and a Spring semester in each year. The summer semester will be utilized for internship or deficiency courses. The maximum duration to complete BS Computer Science degree is 07 years.

Note: Degree requirements may be modified from time to time as per the directions of the concerned regulatory body.

SCHEME OF STUDIES
BS Computer Science

☐ Semester-I (15 Cr. Hrs.)

Course Code	Course Title	Category	Cr. Hrs.
CS1133	Introduction to Programming	Computing Core	3
CS1131	Introduction to Programming Lab	Computing Core	1
HMCS1002	Pakistan Studies	General Education	2
HMCS1013	English-1 (Functional English)	General Education	3
MTCS1013	Calculus and Analytical Geometry	Math & Science	3
PHCS1013	Applied Physics	Math & Science	3

☐ Semester-II (18 Cr. Hrs)

Course Code	Course Title	Category	Cr. Hrs.
CS1143	Object Oriented Programming	Computing Core	3
CS1141	Object Oriented Programming Lab	Computing Core	1
HMCS1012	Islamic Studies/ Ethics	General Education	2
HMCS1023	English-II (Communication Skills)	General Education	3
HMCS1xx3	University Elective-I	University Elective	3
MTCS1033	Linear Algebra	Math & Science	3
CS2053	Discrete Structures	Computing Core	3

☐ Semester-III (17 Cr. Hrs)

Course Code	Course Title	Category	Cr. Hrs.
CS2143	Data Structures	Computing Core	3
CS2141	Data Structures Lab	Computing Core	1
MTCS3063	Probability and Statistics	Math & Science	3
HMCS2033	Technical Report Writing	General Education	3
HMCS2xx3	University Elective-II	University Elective	3
CS2311	Introduction to Database Systems Lab	Computing Core	1
CS2313	Introduction to Database Systems	Computing Core	3

☐ **Semester-IV (18 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
CS3xx3	CS Supporting 1	CS Supporting	3
CS2223	Software Engineering – I	Computing Core	3
CS3413	Operating Systems	Computing Core	3
CS3411	Operating Systems Lab	Computing Core	1
CS3773	Computer Networks	Computing Core	3
CS3771	Computer Networks Lab	Computing Core	1
CS2513	Digital Logic Design	CS Core	3
CS2511	Digital Logic Design Lab	CS Core	1

☐ **Semester-V (16 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
CS2523	Computer Organization & Assembly Language	CS Core	3
CS2521	Computer Organization & Assembly Language Lab	CS Core	1
CS3163	Design and Analysis of Algorithms	CS Core	3
CS3713	Introduction to Information Security and Forensics	Computing Core	3
CS3xx3	CS Supporting 2	CS Supporting	3
CS3613	Theory of Automata & Formal Languages	CS Core	3

☐ **Semester-VI (19 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
CS3433	Parallel and Distributed Computing	CS Core	3
CS3xx3	CS Supporting 3	CS Supporting	3
CS4813	Artificial Intelligence	CS Core	3
CS4811	Artificial Intelligence Lab	CS Core	1
CS3xx3	CS Elective 1	CS Electives	3
CS3xx3	CS Elective 2	CS Electives	3
MGCS4xx3	University Elective-III	University Elective	3

☐ **Semester-VII (17 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
MGCS4xx3	Management Elective-IV	University Elective	3
CS4623	Compiler Construction	CS Core	3
CS4912	Design Project (Part-I)	Computing Core	2
HMCS2013	Professional Ethics and Legal Issues	General Education	3
CS4xx3	CS Elective 3	CS Electives	3
CS4xx3	CS Elective 4	CS Electives	3

☐ **Semester-VIII (10 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
CS4924	Design Project (Part-II)	Computing Core	4
CS4xx3	CS Elective 5	CS Electives	3
HMCS1033	Personal Management and Grooming	General Education	3

MS Computer Science

Admission Requirements

(i) A minimum of 16 years of education leading to BS in Computer Science/Information Technology/Software Engineering or equivalent

(ii) Minimum 2.00/4.00 CGPA or 50% marks

(iii) Admission Test/HEC Approved Test

Degree Requirements

A student admitted in this program will have to complete the degree requirements by following any one of the options given below:

(i) 24 Cr. Hrs course work with 6 Cr. Hrs Thesis

(ii) Course work only (10 Courses)

Core Courses

Students are required to qualify all the core courses listed below:

Course Title	Code	Cr. Hrs.
Advanced Analysis of Algorithms	CS5123	3
Advanced Computer Architecture	CS5413	3
Advanced Operating Systems	CS5433	3
Advanced Theory of Computation	CS5113	3

Specialization Requirements

A student can claim a specialization if he/she has completed 15 Cr. Hrs. including research work, if opted, from one of the specialization areas mentioned below. Otherwise, on the completion of 30 Cr. Hrs., he/she will be awarded the MS Degree without any specialization.

Software Engineering

Course Title	Code	Cr. Hrs.
Advanced Software Architecture	CS5213	3
Requirements Engineering	CS5253	3
Software Engineering Processes	CS5263	3
Software Risk Management	CS6243	3
Semantic Computing	CS6113	3
Formal Methods in Software Engineering	CS5623	3
Model and Specification Based Software Testing	CS5633	3

Ontology Engineering	CS6143	3
Safety-critical Systems	CS6213	3
Software Fault Tolerance	CS6223	3
Advanced Software Testing	CS6233	3
Advanced Software Engineering	CS6263	3
Special Topics in Software Systems & Engineering	CS6xx3	3
Advanced Software Project Management	CS5373	3
Advanced Software Quality Assurance	CS6283	3
Secured Software Development	CS5643	3
Advanced Usability Engineering	CS5653	3

Computer Networks

Course Title	Code	Cr. Hrs.
Multimedia Services over IP Networks	CS6523	3
Advanced Computer Networks	CS6713	3
Internet Protocols	CS5723	3
Network Programming	CS5733	3
Mobile and Wireless Networks	CS6723	3
Network Security	CS5713	3
Topics in Computer Networks	CS6733	3

Artificial Intelligence

Course Title	Code	Cr. Hrs.
Advance Artificial Intelligence	CS5523	3
Pattern Recognition	CS5533	3
Artificial Neural Networks	CS6533	3
Digital Image Processing	CS5553	3
Natural Language Processing	CS5563	3
Text Mining and Information Retrieval	CS5573	3
Decision Support and Expert Systems	CS6563	3

Intelligent Systems	CS5583	3
Fuzzy Systems	CS5533	3
Advance Statistical Analysis	CS6543	3
Knowledge Graph based Systems	CS6553	3

Data Science

Course Title	Code	Cr. Hrs.
Data Mining	CS5343	3
Modeling and Optimization	CS6613	3
Advanced Data Mining	CS6333	3
Data Warehousing	CS5333	3
Distributed Database Systems	CS5323	3
Decision Support Systems	CS5923	3
Web Mining	CS6323	3
Advanced Topics in Data Mining	CS6313	3
Data Visualization	CS5963	3
Algorithms for Data Science	CS5973	3
Statistics for Data Science	CS5983	3
Machine Learning for Data Science	CS5993	3
Semantics for Big Data	CS5833	3
Graph Analytics	CS5843	3
Ontologies for Big Data	CS5853	3
Data Mining of Healthcare Analytics	CS5813	3
Healthcare Data Acquisition	CS5853	3
Embedded Systems for Healthcare	CS5173	3
Internet of Things for Healthcare	CS5143	3

Information Security

Course Title	Code	Cr. Hrs.
Network Security	CS5713	3

Computer Security	CS5753	3
Electronic Warfare-Principles and Techniques	CS5763	3
Cloud Computing Security	CS5773	3
Advanced Cryptography	CS5783	3
Digital Forensics	CS5793	3
Applied Cryptography	CS5953	3
Crypto Analysis	CS6833	3
Cyber Attacks-Modeling and Analysis	CS6843	3
Information Security Policy and Management	CS6853	3
Cyber Forensics and Incident Response	CS6863	3
Semantics for Information Security	CS6873	3

Research Thesis

Course Title	Code	Cr. Hrs.
Research Thesis	CS6916	6

CGPA Requirement

A student is required to earn a minimum 3.00/4.00 CGPA on the completion of his/her degree requirements.

Program Duration

This is normally a two years program comprising of 4 semesters with minimum of 30 semester credit hours. There will be a Fall and a Spring Semester in each year. The maximum duration to complete MS in Computer Science is 4 years.

PhD Computer Science

The Department provides a vibrant and dynamic environment that encourages excellence in research specifically in the areas of Software Engineering, Computer Networks, Web and Information Systems, Data Science and Information Security. The PhD program aims at producing graduates who could meet the challenges of emerging international trends in Computer Science. To achieve this objective, we have a team of highly qualified and dedicated faculty members; a cohesive and carefully designed PhD program. A due emphasis has been placed on the applied and industrial aspects of the research. For this purpose, the Department has established a strong liaison with Research & Development organizations and industry.

■ Admission Requirements

(i) MS degree in relevant discipline

(ii) Minimum CGPA 3.0/4.0 (Semester System) or 60% marks (Annual System)

(iii) Admission Test/GAT General/HEC Test

(iv) Interview

■ Degree Requirements

A PhD candidate shall be awarded degree on successful completion of the following requirements:

(i) 18 Cr. Hrs. Course Work with minimum CGPA 3.00/4.00

(ii) Comprehensive Examination

(iii) 30 Cr. Hrs. Research Work

(iv) Synopsis Defense

(v) Dissertation Foreign Reviews

(vi) Publication of research paper(s) in HEC approved journal.

(vii) Dissertation Final Defense

Note: PhD scholars are required to comply with the following timeline:

Activity	Preferred Time	Maximum
Course Work	2 Semesters	3 Semesters
Comprehensive Exam	3 Semesters	6 Semesters
Synopsis Qualification	4 Semesters	6 Semesters
Thesis Submission	6 Semesters	12 Semesters