FACULTY
OF
COMPUTING

DEAN'S MESSAGE

Dr. Muhammad Abdul Qadir

The faculty of computing aims at producing computer professionals and mathematicians who can meet the challenges of emerging international trends in information technology, mathematics and related disciplines. To achieve this objective, we have a team of highly qualified and dedicated faculty members. In addition to providing strong theoretical foundations, our academic programs place due emphasis on the applied aspects of the disciplines. For this purpose the Faculty has established a strong liaison with Research & Development organizations and industry.

We believe that academic excellence is not possible without a quality research environment. Therefore, high emphasis is placed on research. The Faculty comprises of two departments, the Department of Computer Science, and the Department of Mathematics. Both the Departments offer BS, MS and PhD programs with different specializations. There are over 1100 alumni of the faculty who are contributing effectively in the industry and academia, thus paying their due share towards national growth.

Capital University of Science and Technology

FACULTY MEMBERS

Department of Computer Science

■ **Dr. M. Abdul Qadir**
PhD Parallel Computing (University of Surrey, UK)
MSc Electronics (QAU, Islamabad)
Professor / Dean FoC

■ **Dr. Nayyer Masood**
PhD Computer Science (University of Bradford, UK)
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PhD Mobile Wireless Networks (Universite de-Paris Sud, Orsay, France)
MSc Engineering Management (UET, Taxila, Pakistan)
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Lecturer

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MA Pakistan Studies (University of Sargodha)
MA Islamic Studies (UOS)
MSc Defence and Strategic Studies (QAU, Islamabad)
Lecturer

DEPARTMENT
OF
COMPUTER SCIENCE

HOD'S MESSAGE

Dr. Nayyer Masood

The Department of Computer Science at Capital University of Science & Technology aims at providing education and training at all levels to contribute to the national pool of computer scientists who can meet the demands of the industry and the academia. While the BS program primarily focuses on training students who would assume the role of developers, designers, and architects of computing systems. The MS and the PhD programs focus on preparing researchers and academicians. The prospective practitioners in the field of Computer Science are provided with the necessary skills to construct reliable computing systems by applying scientific, engineering, and management skills, while the prospective researchers are put through rigorous training in the research methodologies. However, the design, the development, and the research activities are structured so as to supplement each other.

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) **Knowledge:** An ability to apply knowledge of mathematics, science, computing fundamentals and computing specialization to the solution of complex computing problems.

(ii) **Problem Analysis:** An ability to identify, formulate, research literature, analyze complex computer science problems, reaching substantiated conclusions using first principles of mathematics, natural sciences and computer sciences.

(iii) **System Design:** An ability to design solutions for complex computer science problems and design systems, component or processes that meet specified needs while maintaining computing standards, cultural, societal, and environmental considerations.

(iv) **Investigation:** An ability to investigate complex computer science problems in a methodical way including literature survey, design and development of systems, analysis and interpretation of computational data, and synthesis of information to derive valid conclusions.

(v) **Computing Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern IT tools, including prediction and modeling, to complex computer science activities, with an understanding of the limitations.

(vi) **Impact Analysis:** An ability to apply reasoning informed by contextual knowledge to assess societal, legal and cultural issues and the consequent responsibilities relevant to professional computer science practice and solution to complex computer science problems.

(vii) **Management Skills:** An ability to demonstrate management skills and apply computing principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

(viii) **Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

(ix) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.

(x) **Communication:** An ability to communicate effectively, orally as well as in writing, on complex computing activities with the computing community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(xi) **Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

■ 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		57
	• Computing Core	33	
	• Computer Science Core	24	
(b)	Supporting Courses		21
	• 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

Course Title	Code	Cr. Hrs.
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	MTCS1023	3
Graph Algorithms	CS3183	3
Theory of Programming Languages	CS3823	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
Accounting-I	ACCS2003	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
Network Design & Management	CS3753	3
Advanced Database Systems	CS3323	3
Introduction to Data Warehousing	CS4333	3
Integrating Information Technologies	CS4353	3
Distributed Application Architecture and Design	CS4363	3
Decision Support & Organizational Intelligence	CS4373	3
System Administration and Management	CS4423	3
Fundamentals of Information Assurance	CS4433	3
Web Frameworks	CS4463	3
Advanced Mobile Application Development	CS4553	3
Advanced Networking	CS4723	3
Wireless Networks and Mobile Systems Architecture	CS4763	3
Enterprise Application Development Lab	CS3181	1
Enterprise Application Development	CS3183	3
Mobile Application Development Lab	CS4191	1
Mobile Application Development	CS4193	3
Web Application Development Lab	CS3191	1
Web Application Development	CS3193	3
Internet of the Things	CS4743	3

Course Title	Code	Cr. Hrs.
Visual Design and Animation	CS4113	3
Wireless Sensor Network	CS4753	3
Special Topics in ICT (with approval of Board of Studies)	CS4xx3	3

b–Information Security and Forensics

Course Title	Code	Cr. Hrs.
Introduction to Information Security and Forensics	CS3713	3
Database Security	CS3823	3
Network Security & Forensics	CS3833	3
Computer Forensics	CS4843	3
Data Security & Cryptography	CS3843	3
Computer and Internet Security	CS4853	3
Web security & Forensics	CS4863	3
Malware Analysis	CS4873	3
Mobile Application Security & Testing	CS4663	3
Wireless Security	CS4833	3
Penetration Testing	CS4893	3
Enterprise Application Development Lab	CS3181	1
Enterprise Application Development	CS3183	3
Mobile Application Development Lab	CS4191	1
Mobile Application Development	CS4193	3
Web Application Development Lab	CS3191	1
Web Application Development	CS3193	3
Blockchain Technology	CS4573	3
Special Topics in ISF (with approval of Board of Studies)	CS4xx3	3

c–CS General Electives

Course Title	Code	Cr. Hrs.
Computer Game Programming	CS3173	3
System Programming	CS3423	3

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CS Seminar	CS4001	1
Operations Research	CS4613	3
Computer Graphics	CS4513	3
Multimedia Applications Development	CS4533	3
Machine Learning	CS4613	3
Natural Language Processing	CS4873	3
Data Mining	CS4223	3
Semantic Web	CS4323	3
Information Visualization	CS4191	3
Introduction to Data Science	CS4883	3
Special Topics in CS (with approval of Board of Studies)	CS4xx3	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 6th semester or after the completion of 90 Cr. Hrs.

■ Community Service (VIS4000)

Each student is required to complete 65 hours community work, usually after 4th 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 130 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.

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

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☐ 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

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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) 27 Cr. Hrs course work with 3 Cr. Hrs Project

(iii) 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

Course Title	Code	Cr. Hrs.
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

■ 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

■ Web & Information Systems

Course Title	Code	Cr. Hrs.
Digital Libraries	CS5153	3
Semantic Web	CS6173	3
Advanced Topics in Digital Libraries	CS6163	3
Web based Knowledge Discovery	CS5163	3
Information Visualization	CS5183	3
Advanced Topic in Web	CS6183	3
Information Retrieval	CS5823	3
Ontologies for Digital Libraries	CS6193	3

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Course Title	Code	Cr. Hrs.
Web and Wireless Based Multimedia Systems	CS6533	3
Internet and Web-based Systems	CS5133	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

■ 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	

Course Title	Code	Cr. Hrs.
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

■ Elective Courses

Course Title	Code	Cr. Hrs.
Software Methodologies	CS5283	3
Enterprise System Architecture	CS5293	3
Database and Information Systems	CS5313	3
Formal Software Specification and Development	CS5613	3
Software Analysis and Design Patterns	CS5243	3
Advanced Cryptography	CS6553	3
Software Risk Management	CS6243	3
Web and Wireless Based Multimedia Systems	CS6533	3
Parallel Processing	CS6123	3
Topics in Communication Networks	CS6743	3
Neural Computing and Genetic Algorithms	CS6813	3
Advanced Artificial Intelligence	CS6823	3
Multimedia Systems	CS5513	3
Multimedia Semantics	CS5543	3
Spatial, Image, and Multimedia Databases	CS6513	3
Topics in Multimedia Systems	CS6543	3
Introduction to Business Intelligence	CS5943	3
Applied Business Intelligence	CS5933	3
Graph Modeling and Mining	CS6623	3
Semantics in Business Intelligence	CS6923	3
Graph Algorithms	CS6423	3
Computational Intelligence	CS5913	3

■ Research Thesis/Project

Course Title	Code	Cr. Hrs.
Research Thesis	CS6916	6
Research Project	CS6913	3

■ 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 Subject/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 (written and oral)

(iii) 30 Cr. Hrs. Research Work

(iv) Synopsis Defense

(v) Dissertation Foreign Reviews

(vi) Publication/Acceptance of at least one research paper 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	4 Semesters
Synopsis Qualification	4 Semesters	6 Semesters
Thesis Submission	6 Semesters	10 Semesters

DEPARTMENT
OF
SOFTWARE ENGINEERING

HOD'S MESSAGE

Dr. Aamer Nadeem

The focus of BS software engineering program is to train the students to apply the software engineering principles by demonstrating competence in communication, planning, analysis, design, construction, testing and development of software systems. Our software engineering program places a great emphasis on hands-on training along with theory classes, the students learn the current tools and technologies used in software industry. In addition to the technical skills and knowledge, the program also focuses on ethical and societal aspects through courses on humanities, personal grooming, and professional ethics. After successful completion of BS software engineering degree, the students can assume the role of software engineer, designer, developer or tester in any reputable organization.

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BS Software Engineering

◼ Program Educational Objectives (PEOs)

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

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

(ii) Demonstrate advancement in software engineering 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(SE) program will possess the following attributes

(i) **Knowledge:** An ability to apply knowledge of mathematics, science, computing fundamentals and computing specialization to the solution of complex software engineering problems.

(ii) **Problem Analysis:** An ability to identify, formulate, research literature, analyze complex software engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences and software engineering.

(iii) **System Design:** An ability to design solutions for complex software engineering problems and design systems, component or processes that meet specified needs while maintaining computing standards, cultural, societal, and environmental considerations.

(iv) **Investigation:** An ability to investigate complex software engineering problems in a methodical way including literature survey, design and development of systems, analysis and interpretation of computational data, and synthesis of information to derive valid conclusions.

(v) **Computing Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern IT tools, including prediction and modeling, to complex software engineering activities, with an understanding of the limitations.

(vi) **Impact Analysis:** An ability to apply reasoning informed by contextual knowledge to assess societal, legal and cultural issues and the consequent responsibilities relevant to professional software engineering practice and solution to complex software engineering problems.

(vii) **Management Skills:** An ability to demonstrate management skills and apply computing principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

(viii) **Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

(ix) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of computing practice.

(x) **Communication:** An ability to communicate effectively, orally as well as in writing, on complex computing activities with the computing community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(xi) **Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

■ **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 Software Engineering degree is required to successfully earn 130 credit hours as per the following detail:

	Area	Cr. Hrs.
(a)	Core Courses	57
(b)	Elective Courses	15
(c)	Supporting Science Courses	12
(d)	SE Domain Supporting	09
(e)	General Education	31
(f)	Internship	0
(g)	Community Service	0
(h)	Project	6
	Total	**130**

■ **Core Courses (57 Cr. Hrs.)**

Course Title	Code	Cr. Hrs.
Introduction to Programming	SE1133	3
Introduction to Programming Lab	SE1131	1
Object Oriented Programming	SE1143	3
Object Oriented Programming Lab	SE1141	1
Data Structures	SE2143	3
Data Structures Lab	SE2141	1
Software Engineering-I	SE2223	3
Introduction to Database Systems	SE2313	3
Introduction to Database Systems Lab	SE2311	1
Discrete Structures	SE2053	3
Operating Systems	SE3413	3

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Operating Systems Lab	SE3411	1
Computer Communications and Networks	SE3773	3
Computer Communications and Networks Lab	SE3771	1
Introduction to Information Security and Forensics	SE3713	3
Software Architecture and Design	SE3313	3(2+1)
Human Computer Interaction	SE3273	3
Software Requirement Engineering	SE3263	3
Software Quality Engineering	SE3613	3
Software Project Management	SE4273	3
Software Re-engineering	SE4283	3
Software Construction and Development	SE3513	3(2+1)
Web Engineering	SE3523	3

■ Elective Courses (15 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Software Engineering-II	SE3233	3
Formal Software Specification	SE3223	3
Software Engineering Processes	SE3253	3
Software Configuration and Change Management	SE4723	3
Component Based Development	SE4293	3
Software Engineering Economics	SE4233	3
Service Oriented Architecture	SE4263	3
Developing Reusable Software	SE4513	3
Evolutionary Software Testing	SE4623	3
Agent Based Software Engineering	SE4313	3
Software Metrics	SE4253	3
Cloud Computing	SE4563	3
Global Software Development	SE4523	3
Web Application Development	SE4713	3(2+1)
Mobile Application Development	SE4193	3(2+1)
Enterprise Application Development	SE4183	3(2+1)
Software Quality Assurance & Testing	SE4243	3
Semantic Web	SE4323	3

Information Visualization	SE4193	3
Automated Software Testing	SE4343	3
Software Design Patterns	SE3543	3
Natural Language Processing	SE4763	3
Model Based Software Testing	SE4363	3
Rapid Application Development	SE3243	3
Secure Software Development	SE3283	3
Artificial Intelligence	SE4813	3
Machine Learning	SE4613	3
Malware Analysis	SE4873	3
Penetration Testing	SE4893	3
Blockchain Technology	SE4573	3
Introduction to Data Science	SE4883	3
Web Security and Forensics	SE4863	3
Database Security	SE3823	3
Data Security and Cryptography	SE3843	3
Web Frameworks	SE4463	3
Internet of the Things	SE4743	3
Advanced Database Systems	SE3323	3
Mobile Application Security and Testing	SE4913	3
Computer Game Programming	SE3173	3

■ Supporting Science Courses (12 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Calculus and Analytical Geometry	MTSE1013	3
Linear Algebra	MTSE1033	3
Applied Physics	PHSE1013	3
Probability and Statistics	MTSE3063	3

■ SE Domain Supporting Courses (09 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Business Process Engineering	SE3833	3
Formal Methods in Software Engineering	SE4113	3

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Course Title	Code	Cr. Hrs.
Operations Research	SE3913	3
Simulation and Modeling	SE3923	3
Stochastic Processes	SE3933	3

■ **General Education Courses (31 Cr. Hrs)**

Course Title	Code	Cr. Hrs.
Pakistan Studies	HMSE1002	2
Islamic Studies	HMSE1012	2
English-I (Functional English)	HMSE1013	3
English-II (Communication Skills)	HMSE1023	3
Technical Report Writing	HMSE2033	3
Personal Management and Grooming	HMSE1033	3
Professional Ethics and Legal Issues	HMSE2013	3
Humanities-I	HMSE2xx3	3
Humanities-II	HMSE2xx3	3
Management-I	MGSE4xx3	3
Management-II	MGSE4xx3	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 Software Engineering by designing and implementing a design project worth 6 Cr. Hrs. The project shall be completed in two parts as given below:

Course Title	Code	Cr. Hrs.
Design Project-I	SE4912	2
Design Project-II	SE4924	4

■ **Internship (SE4100)**

It is mandatory for every student to register in a 6-8 week summer internship program following their 6th semester or after the completion of 90 credit hours. A formal evaluation is carried out and Pass/Fail grade is awarded to the student.

■ **Community Service (VIS4000)**

It is mandatory for every student to get involved in 65 hours community service during summer (not allowed when student is registered for internship) following their 4th semester or after completion of 50 credit hours.

■ **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-year degree program comprising of 8 semesters with minimum of 130 semester credit hours (Cr. Hrs). There will be a Fall and a Spring semester in each year. The summer session will be utilized for internships or deficiency courses. The maximum duration to complete BS is 7 years.

SCHEME OF STUDIES
BS Software Engineering

☐ **Semester-I (15 Cr. Hrs.)**

Course Code	Course Title	Category	Cr. Hrs.
PHSE1013	Applied Physics	Supporting Science	3
SE1133	Introduction to Programming	Core	3
SE1131	Introduction to Programming Lab	Core	1
HMSE1013	English-I	General Education	3
MTSE1013	Calculus and Analytical Geometry	Supporting Science	3
HMSE1002	Pakistan Studies	General Education	2

☐ **Semester-II (18 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
SE1143	Object Oriented Programming	Core	3
SE1141	Object Oriented Programming Lab	Core	1
HMSE1023	English-II	General Education	3
MTSE1033	Linear Algebra	Supporting Science	3
SE2053	Discrete Structures	Core	3
HMSE2053	Humanities-I	General Education	3
HMSE1012	Islamic Studies	General Education	2

☐ **Semester-III (17 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
SE2143	Data Structures	Core	3
SE2141	Data Structures Lab	Core	1
SE2313	Introduction to Database Systems	Core	3
SE2311	Introduction to Database Systems Lab	Core	1
HMSE3123	Humanities-II	General Education	3
HMSE2033	Technical Report Writing	General Education	3
MTSE3063	Probability and Statistics	Supporting Science	3

☐ Semester-IV (17 Cr. Hrs)

Course Code	Course Title	Category	Cr. Hrs.
HMSE1033	Personal Management and Grooming	General Education	3
SE2223	Software Engineering-I	Core	3
SE3773	Computer Communications and Networks	Core	3
SE3771	Computer Communications and Networks Lab	Core	1
SE3413	Operating Systems	Core	3
SE3411	Operating System Lab	Core	1
SE3263	Software Requirement Engineering	Core	3

☐ Semester-V (18 Cr. Hrs)

Course Code	Course Title	Category	Cr. Hrs.
HMSE2013	Professional Ethics and Legal Issues	General Education	3
SE3713	Introduction to Information Security and Forensics	Core	3
SE3312	Software Architecture and Design	Core	2
SE3311	Software Architecture and Design Lab	Core	1
SE3273	Human Computer Interaction	Core	3
SE3xx3	SE Domain I	SE Domain	3
SE3xx3	Elective-I	Elective	3

☐ Semester-VI (18 Cr. Hrs)

Course Code	Course Title	Category	Cr. Hrs.
SE3613	Software Quality Engineering	Core	3
SE3512	Software Construction and Development	Core	2
SE3511	Software Construction and Development Lab	Core	1
SE3523	Web Engineering	Core	3
SE3xx3	SE Domain II	SE Domain	3
SE3xx3	Elective-II	Elective	3
SE3xx3	Elective-III	Elective	3

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☐ **Semester-VII (17 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
SE4273	Software Project Management	Core	3
SE4813	Software Re-Engineering	Core	3
MGSE4xx3	Management-I	General Education	3
SE4912	Project Part-I	Project	2
SE3xx3	SE Domain III	SE Domain	3
SE4xx3	Elective-IV	Elective	3

☐ **Semester-VIII (10 Cr. Hrs)**

Course Code	Course Title	Category	Cr. Hrs.
MGSE4xx3	Management-II	General Education	3
SE4924	Project Part-II	Project	4
SE4xx3	Elective-V	Elective	3

DEPARTMENT OF MATHEMATICS

HOD'S MESSAGE

Dr. Muhammad Sagheer

Mathematics is the backbone of many scientific and engineering fields. It provides a strong theoretical knowledge and techniques essential to understand the fundamentals of such areas as physics, engineering, space science, biotechnology and computer science. With a firm grasp of mathematics, one will have the widest possible base to launch explorations of the related disciplines. The department of Mathematics is offering MPhil and PhD degrees in Mathematics. The highly qualified foreign / local degree holder faculty is guiding and supervising the research students in a variety of the specializations of Pure and Applied Mathematics.

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MPhil Mathematics

■ Admission Requirements

(i) A minimum of 16 years of education leading to BS/MSc degree in Mathematics 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) 27 Cr. Hrs course work with 3 Cr. Hrs Project

(iii) 30 Cr. Hrs. course work

There are no core courses and the students are required to register courses offered by the department from the list appended below:-

■ Elective Courses

Course Title	Code	Cr. Hrs.
Advanced Partial Differential Equations	MT5013	3
Advanced Wave Mechanics	MT5023	3
Integral Equations	MT5033	3
Celestial Mechanics	MT5043	3
Advanced Mathematical Analysis	MT5123	3
Topics in Complex Analysis	MT5133	3
Advanced Functional Analysis	MT5143	3
Fixed Point Theory	MT5153	3
Advanced Numerical Techniques	MT5213	3
Finite Element Methods	MT5233	3
Finite Difference Methods	MT5243	3
Advanced Group Theory	MT5303	3
Computational Algebra	MT5313	3
Non Commutative Algebra	MT5323	3
Algebraic Cryptography	MT5343	3
Advanced Fluid Dynamics	MT5513	3
Non-Newtonian Fluid Mechanics	MT5533	3
Computational Fluid Dynamics	MT5543	3

Optimization Techniques	MT5613	3
Linear System Theory	MT5623	3
Nonlinear Control Systems	MT5633	3
Applied Cryptography	MT5643	3
Stochastic Processes	MT5653	3
Financial Mathematics	MTxxxx	3
Operational Research	MT5723	3
General Relativity	MT5813	3
Special topics in Mathematics	MT5xx3	3

■ Research Thesis/Project

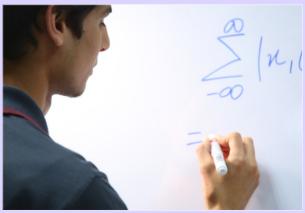| Course Title	Code	Cr. Hrs.
Research Thesis Part-I	MT5913	3
Research Thesis Part-II	MT5923	3
Research Project	MT5933	3

■ 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. There will be a Fall and Spring semester in each year. The maximum duration to complete MPhil in Mathematics is 4 years.

PhD Mathematics

Through the PhD program in Mathematics, we emphasize on bringing the creative abilities of the researchers to the level where they can produce novel ideas to solve an existing problem. To choose a research area, a scholar will have a sufficiently good number of options available in the Department. The interest of scholars in the collaborative work of mathematical nature with other departments of the university will also be encouraged.

■ Admission Requirements

(i) MPhil/MS degree in a relevant discipline

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

(iii) Admission Test/HEC Approved 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 (written and oral)

(iii) 30 Cr. Hrs. Research Work

(iv) Synopsis Defense

(v) Dissertation Foreign Reviews

(vi) Publication/Acceptance of at least one research paper 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	5 Semesters
Synopsis Qualification	4 Semesters	6 Semesters
Thesis Submission	6 Semesters	10 Semesters