

DEPARTMENT OF COMPUTER SCIENCE



Dr. Nayyer Masood
HoD Computer Science

Department Of Computer Science

BS Computer Science

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.

Program Educational Objectives (PEOs)

- i. The graduates will contribute competently in the computing industry by applying requisite technical skills.
- ii. The graduates will demonstrate advancement in computing profession by enhancing their knowledge and skills.
- iii. The graduates will demonstrate ethical values and contribute positively towards the society.

CS Graduate 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.



BS Computer Science

1. Admission Requirements

- a. Higher Secondary School Certificate or equivalent securing at least 45% marks in aggregate.
- b. CUST Admission Test or NTS test.

2. Degree Requirements

Each candidate for the BS Computer Science degree is required to successfully earn 133 credit hours as per the following detail:

Area	Cr. Hrs.
(a) Computer Science Core Courses	57
(b) Elective Courses	24
(c) Supporting Courses	21
(d) General Education	25
(e) Design Project	06
(f) Internship	0
(g) Community Service	0
Total	133

(a) Computer Science Core Courses (57Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Introduction to Programming Lab	CS 1131	1
Introduction to Programming	CS 1133	3
Object Oriented Programming Lab	CS 1141	1
Object Oriented Programming	CS 1143	3
Data Structures Lab	CS 2141	1
Data Structures	CS 2143	3
Software Engineering – I	SE 2223	3
Introduction to Database Systems Lab	CS 2311	1
Introduction to Database Systems	CS 2313	3

Digital Logic Design	CS 2513	3 (2+1)
Computer Organization and Assembly Language	CS 2523	3 (2+1)
Advanced Computer Programming Lab	CS 2151	1
Advanced Computer Programming	CS 2153	3
Design and Analysis of Algorithms	CS 3163	3
Object Oriented Analysis and Design	SE 3213	3
Operating Systems	CS 3413	3
Operating Systems Lab	CS 3411	1
Computer Architecture	CS 3513	3
Theory of Automata and Formal Languages	CS 3613	3
Human Computer Interaction	CS 3273	3 (2+1)
Compiler Construction	CS 4623	3 (2+1)
Computer Communications & Networks	CS 3773	3 (2+1)
Artificial Intelligence	CS 4813	3 (2+1)

(b) Computer Science Elective Courses (24 Cr. Hrs.)

(A student has to take at least five

courses in a particular stream to get that specialization mentioned on his/her transcript)

i. ICT Specialization

Course Title	Code	Cr. Hrs.
Network Programming	CS 3743	3
Network Design & Management	CS 3753	3
Advanced Database Systems	CS 3323	3
Introduction to Data Warehousing	CS 4333	3
Integrating Information Technologies	CS 4353	3
Distributed Application Architecture and Design	CS 4363	3
Decision Support & Organizational Intelligence	CS 4373	3

System Administration and Management	CS 4423	3
Fundamentals of Information Assurance	CS 4433	3
Web Frameworks	CS4463	3
Advanced Mobile Application Development	CS 4553	3
Advanced Networking	CS 4723	3
Wireless Networks and Mobile Systems Architecture	CS 4763	3
Enterprise Application Development Lab	CS 3181	1
Enterprise Application Development	CS 3183	3
Mobile Application Development Lab	CS 4191	1
Mobile Application Development	CS 4193	3
Web Application Development Lab	CS 3191	1
Web Application Development	CS 3193	3
Internet of the Things	CS 4743	3
Visual Design and Animation	CS 4113	3
Wireless Sensor Network	CS 4753	3
Special Topics in ICT (with approval of Board of Faculty)	CS 4xx3	3

ii. Information Security and Forensics

Course Title	Code	Cr. Hrs.
Introduction to Information Security and Forensics	CS 3713	3
Database Security	CS 3823	3
Network Security & Forensics	CS 3833	3
Computer Forensics	CS 4843	3
Data Security & Cryptography	CS 3843	3
Computer and Internet Security	CS 4853	3
Web security & Forensics	CS 4863	3

Malware Analysis	CS 4873	3
Mobile Application Security & Testing	CS 4883	3
Wireless Security	CS 4833	3
Penetration Testing	CS 4893	3
Enterprise Application Development Lab	CS 3181	1
Enterprise Application Development	CS 3183	3
Mobile Application Development Lab	CS 4191	1
Mobile Application Development	CS 4193	3
Web Application Development Lab	CS 3191	1
Web Application Development	CS 3193	3
Special Topics in ISF (with approval of Board of Faculty)	CS 4xx3	3

iii. CS General Electives

Course Title	Code	Cr. Hrs.
Numerical Computing	CS 3073	3
Computer Game Programming	CS 3173	3
Introduction to Graph Algorithms	CS 4123	3
System Programming	CS 3423	3
CS Seminar	CS 4001	1
Operations Research	CS 4613	3
Computer Graphics	CS 4513	3
Multimedia Applications Development	CS 4533	3
Machine Learning	CS 4613	3
Natural Language Processing	CS 4623	3
Data Mining	CS 4623	3
Semantic Web	CS 4323	3

Information Visualization	CS 4191	3
Special Topics in CS (with approval of Board of Faculty)	CS 4xx3	3

(c) Supporting Sciences Courses (21 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Calculus I	MTCS 1013	3
Calculus II	MTCS 1023	3
Linear Algebra	MTCS 1033	3
Applied Differential Equations	MTCS 2043	3
Discrete Mathematics	MTCS 2053	3
Probability and Statistics	MTCS 3063	3
Applied Physics	PHCS 1013	3

(d) Humanities Courses (25Cr. Hrs)

Course Title	Code	Cr. Hrs.
Pakistan Studies	HMCS 1002	2
Islamic Studies	HMCS 1012	2
English-I (Functional English)	HMCS 1013	3
English-II (Communication Skills)	HMCS 1023	3
Technical Report Writing	HMCS 2033	3
Humanity-I: Introduction to Psychology	HMCS 2053	3
or Introduction to Sociology	HMCS 2063	3
or Major World Religions	HMCS 2113	3
Humanity-II: Introduction to Logic	HMCS 3123	3
or Professional Ethics and Legal Issues	HMCS 2013	3

Management I: Accounting-I	ACCS 2003	3
or Introduction to Management	MGCS 1003	3
Management II: Supply Chain Management	MICS 4183	3
Or Project Management	MICS 4xx3	3

(e) Internship (INT 4100)

It is mandatory for every student to participate in an 8 weeks summer internship program following their 6th semester or after the completion of 90 credit hours.

(f) Project:

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 below:

Course Title	Code	Cr. Hrs.
Design Project-I	CS 4912	2
Design Project-II	CS 49244	4

(g) Community Work

Each student is required to complete 60 hours community work, usually after 4th semester which would be a prerequisite to clear the student for the award of degree.

3. Program Duration

This is a four year 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.



Scheme of Study

BS Computer Science Program

Semester-1 (15 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 1133	Introduction to Programming	Core	3	0	3
CS 1131	Introduction to Programming Lab	Core	0	3	1
HMCS 1002	Pakistan Studies	Humanities	2	0	2
HMCS 1013	English-1 (Functional English)	Humanities	3	0	3
MTCS 1013	Calculus-I	Supporting Sciences	3	0	3
PHCS 1013	Applied Physics	Supporting Sciences	3	0	3

Semester-2 (18 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 1143	Object Oriented Programming	Core	3	0	3
CS 1141	Object Oriented Programming Lab	Core	0	3	1
HMCS 1012	Islamic Studies	Humanities	2	0	2
HMCS 1023	English-II (Communication Skills)	Humanities	3	0	3
HMCS 1xx3	Humanities-I	Humanities	3	0	3
MTCS 1023	Calculus-II	Supporting Sciences	3	0	3
MTCS 1033	Linear Algebra	Supporting Sciences	3	0	3

Semester-3 (17 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 2143	Data Structures	Core	3	0	3
CS 2141	Data Structures Lab	Core	0	3	1

CS	2513	Digital Logic Design	Core	2	3	3
HMCS	2033	Technical Report Writing	Humanities	3	0	3
HMCS	2xx3	Humanities-II	Humanities	3	0	3
CS	2311	Introduction to Database Systems Lab	Core	0	3	1
CS	2313	Introduction to Database Systems	Core	3	0	3

Semester-4 (16 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.	
CS	2153	Advanced Computer Programming	Core	3	0	3
CS	2151	Advanced Computer Programming Lab	Core	3	3	1
SECS	2223	Software Engineering – I	Core	3	0	3
CS	2523	Computer Organization & Assembly Language	Core	2	3	3
MTCS	2053	Discrete Mathematics	Supporting Sciences	3	0	3
MTCS	2043	Applied Differential Equation	Supporting Sciences	3	0	3

Semester-5 (16 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.	
MTCS	3063	Probability & Statistics	Supporting Sciences	3	0	3
CS	3163	Design and Analysis of Algorithms	Core	3	0	3
CS	3413	Operating Systems	Core	3	0	3
CS	3411	Operating Systems Lab	Core	0	3	1
CS	3513	Computer Architecture	Core	3	0	3
CS	3773	Computer Communications and Networks	Core	2	3	3

Semester-6 (18 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
SE 3213	Object Oriented Analysis and Design	Core	3	0	3
CS 3613	Theory of Automata & Formal Languages	Core	3	3	1
CS 3273	Human Computer Interaction	Core	2	3	3
CS 3xx3	CS Elective 1	Electives	3	0	3
CS 3xx3	CS Elective 2	Electives	3	0	3
CS 3xx3	CS Elective 3	Electives	3	0	3

Semester-7 (18 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
MGCS 4xx3	Management Elective-I	Humanities	3	0	3
CS 4623	Compiler Construction	Core	2	3	3
CS 4912	Design Project (Part-I)	Design Project	0	6	2
CS 4813	Artificial Intelligence	Core	2	3	3
CS 4xx3	CS Elective 4	Electives	3	0	3
CS 4xx3	CS Elective 5	Electives	3	0	3

Semester-8 (15 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
MGCS 4xx3	Management Elective-II	Humanities	3	0	3
CS 4924	Design Project (Part-II)	Design Project	0	12	4
CS 4xx3	CS Elective 6	Electives	3	0	3
CS 4xx3	CS Elective 7	Electives	3	0	3
CS 4xx3	CS Elective 8	Electives	3	0	3

BS Software Engineering

Program Educational Objectives

- i. The graduates will contribute competently in the software industry by applying requisite technical skills.
- ii. The graduates will demonstrate advancement in software engineering profession by enhancing their knowledge and skills.
- iii. The graduates will demonstrate ethical values and contribute positively towards the society.
- iv. [Complex Software Engineering] An ability to solve 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

SE Graduate 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



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.

BS Software Engineering

1. Admission Requirements

- a. Higher Secondary School Certificate or equivalent securing at least 45% marks in aggregate.
- b. CUST Admission Test or NTS test.

2. Degree Requirements

Each candidate for the BS Software Engineering degree is required to successfully earn 133 credit hours as per the following detail:

Area	Cr. Hrs.
a) Core Courses	60
b) Elective Courses	24
c) Supporting Courses	18
d) General Education	25
e) Design Project	06
f) Internship	0
g) Community Service	0
Total	133

(a) Software Engineering Core Courses (60 Cr. Hrs.)

Course Title	Code	Cr. Hrs.
Introduction to Programming Lab	CS 1131	1
Introduction to Programming	CS 1133	3
Object Oriented Programming Lab	CS1141	1
Object Oriented Programming	CS1143	3
Data Structures Lab	CS 2141	1
Data Structures	CS 2143	3
Software Engineering – I	SE 2223	3
Introduction to Database Systems Lab	CS 2311	1
Introduction to Database Systems	CS 2313	3
Digital Logic Design	CS 2513	3 (2+1)
Advanced Computer Programming Lab	CS 2151	1
Advanced Computer Programming	CS 2153	3
Design and Analysis of Algorithms	CS 3163	3
Object Oriented Analysis and Design	SE 3213	3
Operating Systems	CS 3413	3
Operating Systems Lab	CS 3411	1
Computer Organization and Assembly Languages	CS 2523	3 (2+1)
Human Computer Interaction	CS 3273	3 (2+1)
Computer Communications & Networks	CS 3773	3 (2+1)
Software Requirement Engineering	SE 3263	3
Agile Software Development	SE 3823	3
Software Testing	SE 3633	3
Software Architecture	SE 3643	3
Software Project Management	SE 4273	3

**(b) Software Engineering Elective Courses
(Depth Electives, 24Cr. Hrs.)**

Students are required to take at least five courses from the list given below and

remaining credit hours may be completed by taking courses from any stream offered by the department

Course Title	Code	Cr. Hrs.
Software Engineering-II	SE 3233	3
Software Requirement Engineering	SE 3213	3
Formal Software Specification	SE 3223	3
Software Quality Engineering	SE 3243	3
Software Process Engineering	SE 3253	3
Software Configuration & Change Management	SE 4213	3
Component Based Development	SE 4293	3
Software Quality Assurance & Testing	SE 4243	3
Software Engineering Economics	SE 4233	3
Software Metrics	SE 4253	3
Service Oriented Architecture	SE 4263	3
Developing Reusable Software	SE 4273	3
Evolutionary Testing	SE 4283	3
Web Application Development Lab	CS 3191	1
Web Application Development	CS 3193	3
Mobile Application Development Lab	CS 4191	1
Mobile Application Development	CS 4193	3
Enterprise Application Development Lab	CS 3181	1
Enterprise Application Development	CS 3183	3
Semantic Web	CS 4323	3
Information Visualization	CS 4191	3

(e) Internship (INT4100)

Each student is required to complete an 8-weeks industrial internship training usually after 6 semesters or on the completion of 90 Cr. Hrs. The internship shall be graded as pass/fail.

(f) Design Project

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	SE 4912	2
Design Project-II	SE 4924	4

(g) Community Work

Each student is required to complete 60 hours of community work, usually after 4th semester which would be a prerequisite to clear the student for the award of degree.

3. Program Duration

This is a four year degree program comprising of 8 semesters with a minimum of 133Cr. 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 Software Engineering degree is 07 years.



Scheme of Study

BS Software Engineering Program

Semester-1 (15 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 1133	Introduction to Programming	Core	3	0	3
CS 1131	Introduction to Programming Lab	Core	0	3	1
HMSE 1002	Pakistan Studies	Humanities	2	0	2
HMSE 1013	English-1 (Functional English)	Humanities	3	0	3
MTSE 1013	Calculus-I	General Sciences	3	0	3
PHSE 1013	Applied Physics	General Sciences	3	0	3

Semester-2 (18 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 1143	Object Oriented Programming	Core	3	0	3
CS 1141	Object Oriented Programming Lab	Core	0	3	1
HMSE 1012	Islamic Studies	Humanities	2	0	2
HMSE 1023	English-II (Communication Skills)	Humanities	3	0	3
HMSE 2xx3	Humanities-I	Humanities	3	0	3
MTSE 1023	Calculus-II	General Sciences	3	0	3
MTSE 1033	Linear Algebra	General Sciences	3	0	3

Semester-3 (17 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
CS 2143	Data Structures	Core	3	0	3

CS	2141	Data Structures Lab	Core	0	3	1
CS	2513	Digital Logic Design	Core	2	3	3
HMSE	2033	Technical Report Writing	Humanities	3	0	3
HMSE	2xx3	Humanities-II	Humanities	3	0	3
CS	2311	Introduction to Database Systems Lab	Core	0	3	1
CS	2313	Introduction to Database Systems	Core	3	0	3

Semester-4 (16 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.	
CS	2153	Advanced Computer Programming	Core	3	0	3
CS	2151	Advanced Computer Programming Lab	Core	3	3	1
SE	2223	Software Engineering – I	Core	3	0	3
CS	2523	Computer Organization and Assembly Language	Core	2	3	3
MTSE	2053	Discrete Mathematics	General Sciences	3	0	3
MTSE	3063	Probability & Statistics	General Sciences	3	0	3

Semester-5 (17 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.	
SE	3263	Software Requirement Engineering	Core	3	0	3
CS	3163	Design and Analysis of Algorithms	Core	3	0	3
CS	3413	Operating Systems	Core	3	0	3
CS	3411	Operating Systems Lab	Core	0	3	1

SE	3213	Object Oriented Analysis and Design	Core	3	0	3
SE	3643	Software Architecture	Core	3	0	3

Semester-6 (18 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
SE	3823	Agile Software Development	3	0	3
SE	3633	Software Testing	3	0	3
CS	3273	Human Computer Interaction	3	0	3
CS	3773	Computer Communications and Networks	3	0	3
SE	3xx3	SE Elective 1	3	0	3
SE	3xx3	SE Elective 2	3	0	3

Semester-7 (16Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
SE	4273	Software Project Management	3	0	3
MGSE	4xx3	Management Elective-I	3	0	3
SE	4912	Design Project (Part-I)	3	6	2
SE	4xx3	SE Elective 3	3	0	3
SE	4xx3	SE Elective 4	3	0	3
SE	4xx3	SE Elective 5	3	0	3

Semester-8 (15 Cr. Hrs.)

Course Code	Course Title	Course Category	Lec Hrs.	Lab. Hrs.	Cr. Hrs.
MGSE 4xx3	Management Elective-II	Humanities	3	0	3
SE 4924	Design Project (Part-II)	Design Project	3	12	4
SE 4xx3	SE Elective 6	Electives	3	0	3
SE 4xx3	SE Elective 7	Electives	3	0	3
SE 4xx3	SE Elective 8	Electives	3	0	3



MS Computer Science

1. Admission Requirements

- A minimum of 16 years of education leading to BS in Computer Science/ Information Technology / Software Engineering or equivalent¹.
- Minimum 2.00/4.00 CGPA or 50% marks
- Admission Test / HEC Approved Test

2. Degree Requirements

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

	Area	Cr. Hrs.
(a)	24 Cr. Hrs course work with 6 Cr. Hrs thesis	30
(b)	27 Cr. Hrs course work with 3 Cr. Hrs project	30
(c)	Course work only (10 Courses)	30

3. Core Courses

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

Course Title	Code	Cr. Hrs.
Advanced Analysis of Algorithms	CS 5123	3
Advanced Computer Architecture	CS 5413	3
Advanced Operating Systems	CS 5433	3
Advanced Theory of Computation	CS 5113	3

4. 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.

¹Applicants with undergraduate degree from non-relevant areas may be required to take some undergraduate courses to fulfill pre-requisite deficiencies as determined by the Graduate Admission Committee. The deficiency Cr. Hrs. will not be counted towards the minimum Cr. Hrs. requirement for the award of the MS degree.

i. Software Systems and Engineering

Course Title	Code	Cr. Hrs.
Advanced Software Architecture	CS 5213	3
Requirements Engineering	CS 5253	3
Software Engineering Processes	CS 5263	3
Real Time Systems	CS 6243	3
Semantic Computing	CS 6113	3
Formal Methods in Software Engineering	CS 5623	3
Model and Specification Based Software Testing	CS 5633	3
Ontology Engineering	CS 6143	3
Safety-critical Systems	CS 6213	3
Software Fault Tolerance	CS 6223	3
Advanced Software Testing	CS 6233	3
Advanced Software Engineering	CS 6263	3
Special Topics in Software Systems & Engineering	CS 6xx3	3
Advanced Software Project Management	CS 5373	3
Advanced Software Quality Assurance	CS 6283	3

ii. Multimedia & Communications

Course Title	Code	Cr. Hrs.
Multimedia Systems	CS 5513	3
Advanced Computer Graphics	CS 5523	3
Advanced Multimedia Systems	CS 5533	3
Multimedia Semantics	CS 5543	3
Spatial, Image, and Multimedia Databases	CS 6513	3
Multimedia Services over IP Networks	CS 6523	3

Topics in Multimedia Systems	CS 6543	3
Advanced Computer Networks	CS 6713	3
Internet Protocols	CS 5723	3
Network Programming	CS 5733	3
Mobile and Wireless Networks	CS 6723	3
Topics in Computer Networks	CS 6733	3

iii. Web & Information Systems

Course Title	Code	Cr. Hrs.
Digital Libraries	CS 5153	3
Semantic Web	CS 6173	3
Advanced Topics in Digital Libraries	CS 6163	3
Web based Knowledge Discovery	CS 5163	3
Information Visualization	CS 5183	3
Advanced Topic in Web	CS 6183	3
Information Retrieval	CS 5823	3
Ontologies for Digital Libraries	CS 6193	3
Web and Wireless Based Multimedia Systems	Cs 6533	3
Internet and Web-based Systems	CS 5133	3

iv. Computational Business Intelligence

Course Title	Code	Cr. Hrs.
Data Mining	CS 5323	3
Modeling and Optimization	CS 6613	3
Advanced Topics in Data Mining	CS 6313	3
Data Warehousing	CS 5333	3
Data Analytics	CS 6333	3

Distributed Database Systems	CS 5323	3
Introduction to Business Intelligence	CS 5713	3
Decision Support Systems	CS 5923	3
Applied Business Intelligence	CS 5933	3
Graph Modeling and Mining	CS 6623	3
Semantics in Business Intelligence	CS 6923	3
Web Mining	CS 6323	3
Graph Algorithms	CS 5453	3
Computation Intelligence	CS 5913	3
Advance Topics in Data Mining	CS 6313	3

5. Elective Courses

Course Title	Code	Cr. Hrs.
Software Methodologies	CS 5273	3
Enterprise System Architecture	CS 5283	3
Advanced Data Structures	CS 5443	3
Database and Information Systems	CS 5313	3
Formal Software Specification and Development	CS 5613	3
Topics in Object-Oriented Analysis & Design	CS 5233	3
Software Analysis and Design Patterns	CS 5243	3
Advanced Cryptography	CS 6553	3
Network Security	CS 5713	3
Software Risk Management	CS 6243	3
Software Metrics	CS 6253	3
Web and Wireless Based Multimedia Systems	CS 6533	3

Grid Computing	CS 6113	3
Parallel Processing	CS 6123	3
Topics in Communication Networks	CS 6743	3
Neural Computing and Genetic Algorithms	CS 6813	3
Advanced Artificial Intelligence	CS 6823	3

6. Research Thesis/Project

Course Title	Code	Cr. Hrs.
Research Thesis	CS 6916	6
Research Project	CS 6913	3

7. CGPA Requirement

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

8. 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 Systems & Engineering, Multimedia & Communications, Web and Information Systems and Computational Business Intelligence. 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

- MS degree in relevant discipline*
- Minimum CGPA 3.0/4.0 (Semester System) or 60% marks (Annual System)
- Admission Test / HEC approved Test
- Interview

Degree Requirements

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

- a) 18 Cr. Hrs. Course Work with CGPA > 3
- b) Comprehensive Examination (written and oral)
- c) 30 Cr. Hrs. Research Work
- d) Synopsis Defense
- e) Thesis Foreign Evaluation
- f) Publication/Acceptance of at least one research paper.
- g) Local Defense

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

* Relevancy shall be established by the Graduate Admission Committee.

