Curriculum for MS Computer Science MS (CS)

Mission Statement

The mission of the MS (Computer Science) program is to prepare students to create, apply, and impart knowledge in computer science and to develop independent researchers who can become effective problem solver and have a broad perspective on the established and emerging fields of computing and will actively contribute and serve the local and global communities.

Program Objectives

The MS (Computer Science) comprises of both course work as well as research component. There are four 'core courses' aimed at strengthening the understanding and competence of students in computer science fundamentals. The University expects its MS graduates to pursue careers either as 'Computer Science Faculty Members' or as 'Software Development Managers' in the industry

Learning Outcomes

1. Students will be able to possess advanced knowledge of Computer Science field
2. Students will be able to think creatively and critically; to solve non-trivial problems
3. Students will be able to use computing knowledge to develop efficient solutions for real life problems
4. Students will be able to design solutions and can conduct research related activities

The following core courses are recommended to be completed before entering the MS (CS) program.
1. Analysis of Algorithms
2. Assembly Lang. / Computer Architecture
3. Computer Networks
4. Computer Programming
5. Data Structures
6. Database Systems
7. Operating Systems
8. Software Engineering
9. Theory of Automata

A student selected for admission having deficiency in the above stated courses may be required to study a maximum of FOUR courses, which must be passed in the first two semesters. Deficiency courses shall be determined by the Admissions Committee, before admitting the student.
A student cannot register in MS courses, unless all specified deficiency courses have been passed.

Curriculum for MS-CS

Core Courses

At least four courses must be taken from the following

Course Code	Course Title	Credit Hours
CSC 5111/5112	Advanced Analysis of Algorithms	3
CSC 5121/5122	Advanced Operating Systems	3
CSC 5131/5132	Theory of Programming Languages	3
CSC 5141/5142	Advanced Theory of Automata	3
CSC 5151/5152	Advanced Computer Architecture	3

General Elective Courses

General Elective Courses

Course Code	Course Title	Credit Hours
CSE 6511 /6512	Cloud Computing	3
CSE 6551/6552	Machine Learning	3
CSE 6561/6562	Semantic Web	3
CSE 6581/6582	Information Retrieval	3
CSE 6591/6591	Internet of Things	3
CSE 6601/6602	Information Security	3
CSE 6611/6612	Bioinformatics	3
CSE 6621/ 6622	Information Theory	3
CSE 6631 / 6232	Image Processing	3
CSE 7531 /7532	Big Data Analytics	3
CSE 7541/7542	Software Defined Networking	3
CSE 7621/7622	Deep Learning	3
CSE 7641 /7642	Natural Language Processing	3
CSE 7651/ 7652	Pattern Recognition	3
CSE 7661/7662	Distributed Databases	3
CSE 7681/7682	Design Pattern	3
CSE 7671/7672	Advanced Artificial Intelligence	3
CSE 7691/7692	Blockchain Technology	3
CSE 7701/ 7702	Distributed Systems	3
CSE 7711/7712	Advanced Human Computer Interaction	3
CSE 7721/ 7722	Cyber Security	3
CSE 7731/7732	Network Forensics	3

MS (Computer Science)
2-Year Program (4 Semesters)

Semester I

Course Title	Credit Hours
Core Course – I	3
Core Course – II	3
Core Course – III	3
Total	9-0

Semester II

Course Title	Credit Hours
Core Course – IV	3
Elective I	3
Elective II	3
Research Methodology	3
Total	12-0

Semester III

Course Title	Credit Hours
Elective III	3
Thesis I	3
Total	6-0

Semester IV

Course Title	Credit Hours
Elective IV	3
Thesis II	3
Total	6-0

Total Credit hours: 33

Curriculum for MS Software Engineering, MS (SE)

Mission Statement

The mission of the Masters of Science (Software Engineering) program is to equip students with theoretical and applied knowledge of software for the solution of complex problems. It is aimed to prepare the students to learn independently in a constantly changing discipline.

Program Objectives

The objectives of MS (Software Engineering) program are:

1. Prepare students who can critically apply concepts, theories and practices to provide creative solutions of complex computing problems.

2. Prepare students who can define, plan, implement and test a medium-sized software project using appropriate software engineering processes, methods and techniques.

3. Prepare students to effectively communicate their ideas in written and electronic form, and prepare them to work collaboratively in a team environment.

4. Prepare students with a theoretical software engineering background and applied research needed to enter a doctorate program in software engineering.

5. Prepare students to join an appropriate and respectable level position in a computing-related field, and to maintain their professional skills in rapidly evolving field.

Eligibility Criteria:

The minimum requirements for admission in a Master degree program are:
Sixteen years of education (130 credit hours) in a relevant computing subject with a minimum CGPA of 2.0 (on a scale of 4.0).

Students are required to pass admission entry test conducted by the university or GAT-General (www.nts.org.pk/gat/gat.asp) conducted by the National Testing Service with a minimum 50% cumulative score .The GAT-General test is valid for a period of two years

Note:

The university may recommend deficiency courses, after considering the educational background and knowledge of the candidate.

Duration

Minimum duration for completion of MS degree is two years. HEC allows a maximum period of four years to complete MS degree requirements

Degree Completion Requirements

To become eligible for award of MS degree, a student must satisfy the following requirements:

a) Must have earned **CGPA** (Cumulative Grade Point Average) **of at least 2.5 on a scale of 4.0**.

b) Must have studied and passed the **24 credit hours** of courses from the prescribed course list and successfully completed **6 credit hours** of Thesis/Research Work.
The Head of Department may allow the student to do course work of 6 credit hours in lieu of 6 credit hours of research. This exemption can only be allowed if the student wants to terminate his/her course at MS and do not want to do PhD.

Note:

- Students opting for non-thesis based MS are required to complete 6 credit hr. research work before admission in PhD program.
- Minimum 3.0 CGPA is required for admission in PhD program.

Curriculum for MS-SE

Core Courses

Course Code	Course Title	Credit hours
SEC 5111/5112	Advanced Requirements Engineering	3-0
SEC 5121/5122	Advanced Software System Architecture	3-0
SEC 5131/5132	Software Testing and Quality Assurance	3-0
SEC 5141/5142	Research Methodology	3-0
	Total	**12 (12-0)**

Domain Elective Courses

	Course Title	Credit hours
SED 6211/6212	Software Measurement and Metrics	3-0
SED 6221/6222	Component Based Software Engineering	3-0
SED 6231/6231	Advanced Formal Methods	3-0
SED 6241/6242	Advanced Human-Computer Interaction	3-0
SED 6251/6252	Agile Software Development Methods	3-0
SED 6261/6262	Empirical Software Engineering	3-0
SED 6271/6272	Advanced Software Project Management	3-0
SED 6281/6282	Software Configuration Management	3-0
SED 6291/6292	Software Risk Management	3-0
SED 6301/6302	Reliability Engineering	3-0
SED 6311/6312	Software Requirements Elicitation	3-0
Total (Any 2 of the above for thesis option **OR** any 2-4 courses for non-thesis option)		

General Elective Courses

Course Code	Course Title	Credit hours
SEE 6511 /6512	Cloud Computing	3-0
SEE 7531 /7532	Big Data Analytics	3-0
SEE 7541/7542	Software Defined Networking	3-0
SEE 6551/6552	Machine Learning	3-0
SEE 6561/6562	Semantic Web	3-0
SEE 6571/6572	Cyber Security	3-0
SEE 6581/6582	Information Retrieval	3-0
SEE 6591/6591	Internet of Things	3-0

SEE 6601/6602	Information Security	3-0
SEE 6611/6612	Bioinformatics	3-0
SEE 7731/7732	Deep Learning	3-0
SEE 6621/ 6622	Information Theory	3-0
SEE 6631 / 6232	Image Processing	3-0
SEE 7641 /7642	Natural Language Processing	3-0
SEE 7651/ 7652	Pattern Recognition	3-0
SEE 7661/7662	Distributed Databases	3-0
SEE 7671/7672	Advanced Artificial Intelligence	3-0
SEE 7681/7682	Design Pattern	3-0
SEE 7691/7692	Blockchain Technology	3-0
SEE 6741/6742	Bio inspired AI	3-0
SEE 7821/7822	Recent Trends in AI	3-0
SEE 7701/ 7702	Distributed Systems	3-0
Total (Any 3 of the above for thesis option **OR** any 3-5 courses for non-thesis option)		

MS (Software Engineering)

2-Years Program 4 Semesters)

Semester I

Course Title	Credit Hours
Advanced Requirements Engineering	3-0
Advanced Software System Architecture	3-0
Research Methodology	3-0
Total	9-0

Semester II

Course Title	Credit Hours
Software Testing and Quality Assurance	3-0
Elective I	3-0
Elective II	3-0
Total	9-0

Semester III

Course Title	Credit Hours
Elective III	3-0
Thesis I/ (Elective IV)	3-0
Total	6-0

Semester IV

Course Title	Credit Hours
Elective V	3-0
Thesis II / (Elective VI)	3-0
Total	6-0

Total Credit hours: 30

Curriculum for PhD Computer Science

Introduction

The PhD program in Computer Science offers a comprehensive and professionally-oriented education that combines the foundation of computer science with the applied and in-demand skills necessary for careers in existing and emerging technologies

The PhD program in Computer Science encourages students to tackle both coursework and research in parallel; success in both of these components is a necessary requirement for the award of the PhD degree.

The PhD program requires candidates to undertake a number of graduate level courses, pass a qualifying examination, and then carry out research in a chosen area. The candidates are required to publish research papers in peer-reviewed international conference proceedings and recognized credible journals.

PhD Program Outcomes

- Students will be able to exhibit specialized domain knowledge and ability to use appropriate research methodology in the relevant field of study.
- Students will be able to conduct systematic and focused research.
- Students will be able to publish research papers in journals and conference proceedings of international repute.
- Students will be able to conduct and supervise independent research and can produce innovative knowledge.

Objectives of the Program

The objectives of PhD program are to:

1. Prepare students who can critically apply concepts, theories and practices to provide creative solutions of complex computing problems.

2. Prepare highly qualified researchers required for the expansion of fundamental knowledge and technological innovation through research and development, as well as the needs of institutions of higher learning.

3. Prepare students who can exhibit technical communication, collaboration and mentoring skills and assume roles both as team members and as team leaders in research and development in the computing field.

4. Prepare students who can adapt technological advances through active participation in life-long learning.

5. Prepare students who can exhibit a reasoned understanding of professional ethics and the roles of regulations and guidelines in the profession, including global cultural awareness and environmental impacts

Entry/ Admission requirement of program

The degree awarded by the University must meet the following minimum criteria for recognition by the HEC.

Eligibility

- 18 years of education in the field of computing such as Computer Science, Software Engineering, Information Technology, Data Science, Software Project Management, Information Security and equivalent degree earned from a recognized university   <mark>AND</mark>
- At least 70% marks (in the Annual system) or CGPA of at least 3.0 (on a scale of 4.0)

PhD Coursework

PhD coursework comprises 6 courses (total 18 credit hours). A non-credit course "Research Methodology" must also be passed; unless already passed during MS coursework.

Comprehensive Examination

The student becomes eligible to appear in the Comprehensive Examination after passing the PhD coursework with a minimum CGPA of 3.0. This exam must be passed within two years of admission, failing which the admission shall be cancelled

Approval of Synopsis

After passing the coursework with CGPA 3.0 and comprehensive examination, the student will apply through proper channel for confirmation and approval of research title. The student shall submit a synopsis and a copy of the marks proforma issued by the examination department.

Plagiarism Test

The Plagiarism Test must be conducted on the Dissertation before its submission to the two foreign experts.

PhD Thesis Review Policy

- After completing research work, softcopy of compiled thesis will be submitted in BASR for plagiarism check. As per HEC rule below 19% plagiarism is accepted.
- The thesis will be evaluated by two foreign experts from developed/technically advanced countries and two experts from within country.
- Thesis evaluation report will open in BASR meeting and recommended for viva voce examination

Policy for Publication of Research Paper

Publication of at least one research paper in an HEC approved "W" or "X" category journal is a requirement for the award of PhD degree.

Open Defense

After receiving positive comments from the local experts, the student will defend her thesis in front of a panel. After successful defense of the thesis, PhD degree will be awarded.

Copy of PhD Dissertation to HEC

A copy of PhD Dissertation (both hard and soft) must be submitted to HEC for record in PhD Country Directory and for attestation of the PhD degree by the HEC in future

Structure of PhD program after completing 18 years of education

PhD (Computer Science)

3-Year Program (6 Semesters)

Semester I

Course Title	Credit Hours
Elective I	3
Elective II	3
Elective III	3
Total	**9-0**

Semester II

Course Title	Credit Hours
Elective IV	3
Elective V	3
Elective VI	3
Total	**9-0**

Semester III

Course Title	Credit Hours
Research Thesis - I	3
Research Thesis - II	3
Total	**6-0**

Semester IV

Course Title	Credit Hours
Research Thesis - III	3

Research Thesis - IV	3
Total	**6-0**

Semester V

Course Title	Credit Hours
Research Thesis - V	3
Research Thesis - VI	3
Total	**6-0**

Semester VI

Course Title	Credit Hours
Research Thesis - VII	3
Research Thesis - VIII	3
Total	**6-0**

Total Credit hours: 42

General Elective Courses

Course Code	Course Title	Credit Hours
CSE 6511 /6512	Cloud Computing	3
CSE 6551/6552	Machine Learning	3
CSE 6561/6562	Semantic Web	3
CSE 6581/6582	Informational Retrieval	3
CSE 6591/6591	Internet of Things	3
CSE 6601/6602	Information Security	3
CSE 6611/6612	Bioinformatics	3
CSE 6621/ 6622	Information Theory	3
CSE 6631 / 6632	Image Processing	3
CSE 7531 /7532	Big Data Analytics	3
CSE 7541/7542	Software Defined Networking	3
CSE 7731/7732	Deep Learning	3
CSE 7641 /7642	Natural Language Processing	3
CSE 7651/ 7652	Pattern Recognition	3
CSE 6571/6572	Cyber Security	3
CSE 7681/7682	Design Pattern	3
CSE 7671/7672	Advanced Artificial Intelligence	3
CSE 8751/8752	Advanced Operations Research	3
CSE 8761/8762	Advance Topics in Computer Architecture	3
CSE 8771/8772	Advanced Computer Vision	3
CSE 8781/8782	Quantum Computing	3

CSE 7691/7692	Blockchain Technology	3
CSE 8791/8792	Distributed Operating Systems	3
CSE 8801/8802	Advanced Distributed Databases	3
CSE 7811/7812	Advanced System Architecture and Design	3
CSE 6741/6742	Bio inspired AI	3
CSE 7821/7822	Recent Trends in AI	3