## Curriculum

The Curriculum Development Committee followed the recommendations and requirements of the National Qualifications Framework issued by the Education and Training Evaluation Commission, as well as the programmatic accreditation requirements of the National Center for Academic Accreditation and Assessment, in developing the curriculum for the program. They also referred to benchmark comparisons with distinguished international universities in the field of Computer Science.

The curriculum for the Master of Science program in Computer Science (a coursework and thesis-based academic master's) consists of 48 credit hours distributed across six levels. Completing the program requires a minimum duration of two academic years, along with the completion of a scientific thesis. The program's credit hours are divided into 16 mandatory courses, 20 elective courses, and 12 hours for the scientific thesis.

# M.Sc. in Computer Science

| Credit Hours | Course Name | Course Code | |
|---|---|---|---|
| 4 | Advanced Computer Algorithms | CS6600 | First Level |
| 4 | Elective 1 | CS6xxx | |
| 4 | Advanced Computer Networks | CS6630 | Second Level |
| 4 | Elective 2 | CS6xxx | |
| 4 | Advanced Software Engineering | CS6680 | Third Level |
| 4 | Elective 3 | CS6xxx | |
| 4 | Elective 4 | CS6xxx | Forth level |
| 4 | Elective 5 | CS6xxx | |
| 2 | Seminar in Research Methods | CS6795 | Fifth Level |
| 2 | Research Study | CS6797 | |
| 12 | Thesis | CS6799 | Sixth Level |

# Core Courses

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Computer Algorithms** | **CS6600** |

This course provides comprehensive knowledge of modern computer algorithms for solving scientific and engineering problems efficiently and accurately. The students will be guided on how to analyze complex algorithms comparing their efficiencies. Students will not only be taught the design of the existing algorithms but on the other hand it will be focused to teach them designing techniques using rigorous mathematical approaches. The students will be motivated to think about procedures for solving real-world problems optimally and correctly. Real-world problems will be taken as examples to create feelings about the usefulness of this course. The students can also produce a publishable SCI/EI index journal research paper at the end of this course as a final assignment.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Computer Networks** | **CS6630** |

This course addresses current issues concerning the Internet. Topics cover the fundamentals of Internet technology, routing and congestion control, techniques for supporting quality of service in the Internet, traffic engineering, software-defined networking, network functions virtualization, and service function chaining. The course will prepare students for pursuing research is this fast-growing area. It will also help in meeting the demands of industry in this important area of expertise. Major topics include: Internet Infrastructure, TCP/IP, Congestion Control, Quality of Service (Integrated Services, differentiated Services), MPLS, IPv4, and IPv6.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Software Engineering** | **CS6680** |

The course will cover all phases of the software lifecycle and focusing historically situated analysis of Software Engineering. This includes the topics about the fundamental insights about software development, methodologies and approaches, modeling, and software architectures in context. In addition, the course will cover the current new topics discussed in software engineering domain such as the practical topics including open-source development processes (using build systems, cloud-based systems, Kubernetes and docker, new version control systems such as git and GitHub, etc.).
This course aims to equip students to develop techniques of software-intensive systems through successful requirements gathering and engineering, design and implementation, testing, maintenance and evolution, and quality assurance and management. Finally, students build on their basic software engineering knowledge by extending it with specific techniques for maintenance, evolution, dependability, reliability, safety, security, and resilience.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Seminar in Research Methods** | **CS6795** |

The course will outline the fundamentals of doing research. It will introduce topics and issues in professional and research practice for computing professionals in an academic context. This will include the philosophy of research, qualitative and quantitative research, accessing and evaluating research materials, assessing outcomes, and dissemination.
Topics to be covered target two main skills: (1) Research skills include Introduction to research, research process, research methods, scientific paper and technical report writing, and research tools. (2) Communication skills include critical thinking, teamwork and team communications, oral communications, and presentation skills.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **2** | **Research Study** | **CS6797** |

This research study course is a pre-requisite for registering for the master thesis. Initially, students are associated with potential supervisors based on research interests. Then, students are guided by those supervisors toward writing a complete master thesis proposal. This course is conducted as weekly lectures and meetings in which students and supervisors discuss research topics related to the thesis proposal.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **12** | **Thesis** | **CS6799** |

The thesis aims to introduce students to scientific research in the computer sciences (CS) discipline. The students will explore in depth one of the computer science areas and apply the knowledge acquired through the core and elective courses of the program.
The main research topics in CS program include Problem-Solving, Algorithm Analysis, Computer Networks, System Security, Software Engineering and Selective topics from Artificial intelligence, such as machine learning, natural language processing, computer vision, constraint-based reasoning, deep learning, data mining and so on.

The students are expected to understand the topics of some research questions, study the literature review, analyze the existing solutions, and propose strategies, recommendations, and answers to the raised research questions.

# Elective Courses

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Machine Learning** | **CS 6662** |

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Based on fundamental knowledge of computer science principles and skills, probability and statistics theory, and the theory and application of linear algebra. This course provides a broad introduction to machine learning and statistical pattern recognition. It will familiarize students with a broad cross-section of models and algorithms for machine learning and prepare students for research or industry application of machine learning techniques.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Optimization & Metaheuristics** | **CS6618** |

This course presents an overview of the main metaheuristics used to solve hard optimization problems. Many real-life applications in several disciplines such as engineering, operational research, bioinformatics, robotics, etc., involve hard optimization problems. This course aims to introduce the fundamentals of metaheuristic optimization, as well as some popular metaheuristic algorithms, e.g., genetic algorithms, simulated annealing, tabu search and others.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Deep Learning** | **CS6615** |

The aim of this course is to introduce Deep Learning concepts and their role in Artificial Intelligence. These concepts include machine learning, regression and probability distributions. Additionally, the course addresses the regularization and optimization of Deep Neural Networks (DNNs). The course also covers the anatomy of several DNN architectures and their applications, such as Convolutional Neural Networks, Sequence to Sequence Models, Attention Models, Autoencoders, Variational Autoencoders, and Deep Boltzmann Machines. The course also reviews Representation Learning and Reinforcement Learning concepts.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Natural Language Processing** | **CS6661** |

The aim of this course is to introduce concepts of NLP and their role in Artificial Intelligence. It covers the underlying concepts in regular expressions and language modeling. The course introduces vector semantics and embedding, which form the basis for Neural Language models such as recurrent neural networks, encoder-decoder models, attention and contextual embedding. The course also covers constituency grammar and parsing. Many NLP tasks will be studied including text classification, information extraction, coreference resolution, discourse analysis, summarization, dialog systems and machine translation. Advances in Arabic language processing will be reviewed.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Cryptography** | **CS 6735** |

This course covers the basic topics in the field of cryptographic algorithms and their applications. This includes the basic Cryptography terminologies, secure/unsecure channel, attackers and their capabilities, encryption, decryption, keys and their characteristics, signatures, Cipher types together with typical attack methods such as frequency Analysis. Furthermore, the course covers Public Key Infrastructure support for digital signature and encryption and its challenges.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Computer Architecture** | **CS6620** |

This course covers the modern eras of computer architecture that are essential to apply these insights and principles to future computer designs. The course covers in depth the MIPS architecture, Pipelining, Instruction Level Parallelism, Loop unrolling, Branch Handling, Main Memory vs Cache Innovations, Superscalar Computers, Out-of-order Processors, More Dynamic ILP, VLIW computers and dynamic scheduling. The course also introduces students to the recent studies in the computer architecture field.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Operating Systems** | **CS6621** |

The course involves teaching advanced operating system topics followed by reading and understanding classic and new research papers. The course focuses on topics related to operating system structure, virtualization Xen and the art of Virtualization, and Parallel systems. It covers in depth the different concepts of distributed systems including distributed objects, subsystems, and middleware. It also introduces the students to selected developed advanced fields in OS such as Failures and Recovery and MapReduce (The Hadoop Distributed File System).

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Network Security** | **CS6632** |

This course addresses some of the advanced network security concepts. The topics include the following:

Attacker goals, capabilities, and motivations (such as underground economy, digital espionage, cyberwarfare, insider threats, hacktivism, advanced persistent threats)

Network specific threats and attack types (e.g., denial of service, spoofing, sniffing and traffic redirection, Social engineering (e.g., phishing)

Examples of malware (e.g., viruses, worms, spyware, botnets, Trojan horses or rootkits)

Man-in-the-Middle, message integrity attacks, routing attacks, and traffic analysis

Wireless and Mobile networks attacks.

Defense mechanisms and countermeasures (e.g., network monitoring, intrusion detection, firewalls, spoofing and DoS protection, honeypots, tracebacks, and Vulnerability analysis)

Web security model and web application attacks

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Advanced Database Management Systems** | **CS6670** |

This course covers the fundamentals of advanced database management systems that are essential to handle massive amounts of data. The course focuses on topics related to storing, accessing, and querying persistent large data. It covers in-depth the use of indexes to answer queries efficiently over stored data. It also introduces the students to selected developed advanced fields in databases such as data mining and data information retrieval.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Selected Topics in Algorithms Analysis** | **CS6601** |

This graduate level course introduces latest trends in both industry and research as well as advanced topics related to the design and analysis of algorithms. The students will learn advanced topics in this field of study such as Advanced Graph Algorithms, NP-Completeness and Approximation Algorithms, Parallel and Distributed Algorithms, … etc. The course has a mix of traditional lectures and research papers. It is designed for computer science students with solid knowledge in the field of algorithms analysis and design.
Professors responsible for teaching this course will continuously update its content according to recent research trends and topics that are actively studied by algorithms researchers

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Selected Topics in Computer Systems** | **CS6624** |

This graduate level course introduces latest trends in both industry and research as well as advanced topics related to the field of computer systems analysis and design. The students will learn advanced topics in relevant areas such as operating systems, database systems, file systems, distributed systems and networking. The course has a mix of traditional lectures and research papers. It is designed for computer science students with solid knowledge in the field of computer systems design.
Professors responsible for teaching this course will continuously update its content according to recent research trends and topics that are actively studied by systems researchers.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Selected Topics in Networks and Security** | **CS6652** |

This graduate level course introduces latest trends in both industry and research related to the areas of computer networks and security. It is designed for computer science students with basic knowledge in digital communications, algorithms, computer networks, and cybersecurity. The students will learn advanced topics in this field of study such as Wireless networks technology, recent security threats, modern and trusted defense techniques, and cryptographic algorithms.
Professors responsible for teaching this course will continuously update its content according to recent trends in research and industry.

| Credit Hours | Course Name | Course Code |
|---|---|---|

| | | |
|---|---|---|
| **4** | **Cloud Computing** | **CS6653** |

Cloud computing enables ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources such as networks, servers, storage, and applications that can be provisioned and managed seamlessly.

| Credit Hours | Course Name | Course Code |
|---|---|---|
| **4** | **Selected Topics in Artificial Intelligence** | **CS6664** |

This graduate level course introduces latest trends in both research and industry related to the field of Artificial Intelligence (AI). The course has a mix of traditional lectures and research papers. It is designed for computer science students with solid knowledge in Artificial Intelligence algorithms, and machine learning. The students will learn advanced topics in this field of study such as deep learning, constraint programming, knowledge representation and reasoning, optimization…. etc.

Professors responsible for teaching this course will continuously update its content according to recent trends in AI and the research interest of the AI research team in the department.