Yarmouk University

Hijjawi Faculty for Engineering Technology

Computer Engineering Department

Curriculum for Master of Science in Computer Engineering

" Comprehensive Exam Track"

2022

Curriculum

A. Academic Qualifications:

Students wishing to enroll in this program must satisfy the following two conditions:

- Fulfill the degree requirements according to Yarmouk university graduate studies regulations.
- Have a bachelor's degree in Computer Engineering, Electrical Engineering (in all its branches), Mechatronics Engineering, Industrial Engineering, Computer Science, Computer Information Systems, or an equivalent degree. Other degrees are subject to Departmental approval.
- Any other regulations approved by the Department council and committees.

B. Degree Requirements:

- Fulfill the requirement for graduation according to Yarmouk university graduate studies regulations.
- Accomplish prerequisite courses determined by the Department Graduate Studies committee.
- Accomplish a total of **(33)** credit hours as listed below:

1. Core Courses: (24) credit hours

Course Code	Course Number	Course Name	Credits
CPE	600	Advanced Computer Networks	3
CPE	620	Embedded Systems	3
CPE	630	Distributed Systems	3
CPE	680	Advanced Computer Architecture	3
CPE	681	Advanced Computer Operating Systems	3
CPE	682	Systems Modeling and Simulation	3
CPE	690	Scientific Writing and Communication	2
CPE	691	Seminar	1
CPE	964	Graduation Project	3

2. Elective Courses: (9) credit hours

Course Code	Course Number	Course Name	Credits
CPE	601	Wireless Computer Networks	3
CPE	602	Reliability and Fault Tolerance of Computer Networks	3
CPE	603	Multimedia Networking and Communication	3
CPE	604	Network Flows	3
CPE	610	Big Data and Cloud Computing Fundamentals	3
CPE	612	Artificial Intelligence and Machine Learning	3
CPE	613	Advanced Algorithms	3
CPE	614	Pattern Recognition	3
CPE	621	Design of Digital Systems Using FPGAs	3
CPE	622	Digital Hardware Design Using VHDL	3
CPE	623	Real-time Embedded Systems	3
CPE	631	Parallel System Architectures	3
CPE	632	Parallel and High-Performance Computing	3
CPE	633	Data Intensive Computing	3
CPE	692	Special Topics in Computer Engineering	3

3. Pass the Comprehensive Exam (CPE 698) according to Yarmouk university regulations.

The comprehensive exam is **zero (0)** credit hours appearing for registration purposes as follows:

Course Code	Course Number	Course Name	Credits
CPE	698	COMPREHENSIVE EXAM	0

Courses Descriptions

CPE 600: Advanced Computer Networks (3 Hours)

This course aims at introducing students to advanced topics in high-speed computer networks. The course covers the following topics: TCP/IP; Frame relay; Asynchronous transfer mode (ATM), High-speed LANs, TCP traffic control, Interior and exterior routing protocols; Integrated and differentiated services; Protocols for QoS support.

CPE 601: Wireless Computer Networks (3 Hours)

This course aims at introducing students to the fundamentals of wireless communication and networking, and to familiarize students with the modern wireless networking paradigms and wireless technologies and standards. This course covers the following topics: wireless transmission fundamentals; wireless communication technologies; Wireless LAN Technology and the IEEE 802.11 Wireless LAN Standard; Bluetooth and IEEE 802.15; Cellular Wireless Networks; Fourth Generation Systems and Long Term Evolution; Mobile Applications and Mobile IP; Long-Range Communications; emerging wireless networking paradigms.

CPE 602: Reliability and Fault Tolerance of Computer Networks (3 Hours)

The main goal of this course is to provide students with a good understanding of the fundamental concepts of fault tolerance and reliability analysis, in addition to fault modeling, diagnosis, and simulation. The course also aims at making students master reliability and fault tolerance techniques in computer systems and networks. This course covers the following topics: Fundamental concepts in the theory of reliable computer systems; Reliability models and evaluation techniques; Availability and survivability of computer systems; Reliability and fault tolerance of computer networks; Fault tolerant routing techniques.

CPE 603: Multimedia Networking and Communication (3 Hours)

This course aims at introducing students to multimedia networks in terms of used protocols, design principles, and applications. This course covers the following topics: types to multimedia networks; multimedia applications; multimedia coding and transmission; multimedia network functions (RTP, SDP, Streaming, Multicast, NTP, Caching); synchronization and adaptation; Session Initiation Protocol (SIP); VoIP protocols; WebRTC; IPTV; Over-The-Top TV.

CPE 604: Network Flows (3 Hours)

The objectives of this course are to introduce the basics of graph theory and network flows, to explain the fundamental problems in network flows, and to enable students to master the various algorithms to solve network flow problems. This course covers the following topics: graphs and graph terminology, design and analysis of network flow algorithms, shortest-path problem, min-cost flow, maximum flows, assignments and matching, minimum spanning trees, and multi-commodity flows.

CPE 610: Big Data and Cloud Computing (3 Hours)

The main objective of this course is for students to gain knowledge and expertise in the emerging field of big data and cloud computing. The course introduces the concepts of content delivery networks (CDNs), data centers and Big Data. It covers the best practices used to provide reliable data storage, processing, and retrieval to support ever-growing services and applications. It also introduces the concepts like data pipelining, and distributed systems capacity planning and consistency models. The course will also help in identifying bottleneck and performance issues in existing infrastructures. The course teaches the fundamentals of working with distributed and unstructured data with large volumes using open source frameworks like Apache Spark and Apache Hadoop.

CPE 612: Artificial Intelligence and Machine Learning (3 Hours)

The objective of this course is for students to gain a profound understanding of the theories, algorithms, and applications of the state-of-the-art of artificial intelligence and machine learning methods. This course covers the theory and practice of artificial intelligence (AI) and machine learning (ML) from a variety of perspectives. AI topics such as search (uninformed, informed, local optimizing), and planning (navigational, motion) will be covered. ML Topics such as learning decision trees, neural network learning, statistical learning methods, genetic algorithms, Bayesian learning methods, explanation-based learning, and reinforcement learning will be covered. The course covers theoretical concepts such as inductive bias, the PAC and mistake-bound learning frameworks, and minimum description length principle.

CPE 613: Advanced Algorithms (3 Hours)

The goal of this course is for students to learn the main techniques of algorithm analysis and design while building a repertory of basic algorithmic solutions to problems in many domains. This course covers the following topics: Design and analysis of noncommercial problems involving sorting, searching, scheduling, graph theory, and geometry; Design techniques such as approximation, branch-and-bound, divide-and-conquer, dynamic programming, greed, and randomization applied to polynomial and NP-hard problems; Analysis and space utilization. Implementation of Algorithms will be based on advanced data representation techniques and object oriented modeling.

CPE 614: Pattern Recognition (3 Hours)

The main objective of this course is for students to gain a profound understanding of the theories, algorithms, and applications of the state-of-the-art of statistical pattern recognition, various mathematical approaches, and the applications to image and video pattern analysis and recognition. This course will introduce the fundamentals of statistical pattern recognition. It first focuses on generative methods such as those based on Bayes decision theory and related techniques of parameter estimation and density estimation. Next, it discusses discriminative methods such as nearest-neighbor classification and support vector machines. While methods of pattern recognition are useful in many applications, this course will emphasize on computer vision applications.

CPE 620: Embedded Systems (3 Hours)

The aim of this course is to enable students to understand the principles of embedded computing systems as well as to design and analyze such systems. This course covers the following topics: Embedded microprocessors, embedded memory and I/O devices, component interfaces, embedded software, program development, basic compiler techniques, platform-based FPGA technology, hardware synthesis, design methodology, real-time operating system concepts, performance analysis and optimizations.

CPE 621: Design of Digital Systems Using FPGAs (3 Hours)

The aim of this course is to enable students to design digital logic systems using FPGAs. This course covers the following topics: Basic semiconductor physics, digital logic families, design methodologies, digital logic circuits, programmable logic devices, digital logic implementation with CPLD and FPGA, Verilog compilation for CPLDs and FPGAs, synthesis of Altera CPLD and FPGA, synchronous versus asynchronous design, clock skew and path delays, PCB layout, post routing issues, embedded RAM and design criteria.

CPE 622: Digital Hardware Design Using VHDL (3 Hours)

This course aims at enabling students to design digital logic systems using a standard hardware description language. The course covers the following topics: VHDL for digital design, VHDL module and coding structure: data types, expressions, and statements. Hierarchical design approach, verification methodologies, simulator compiler control, value change dump, sample design for simulation, designing combinational and sequential circuits, finite state machines, and test benches.

CPE 623: Real-Time Embedded Systems (3 Hours)

The goal of this course is for students to master the fundamentals of real-time embedded systems design and implementation. This course introduces students to the necessary concepts and empowers them with necessary skills needed to design real-time embedded computer systems. The topics this course covers include: basics of embedded systems and embedded systems programming; real-time operating systems; tasks and task scheduling; inter-process communication; real-time services; I/O and memory management; synchronization, communication, and concurrency; common design problems and case studies.

CPE 630: Distributed Systems (3 Hours)

The objective of this course is to enable students to develop a solid understanding of distributed systems in terms of their importance, types, architectures, design philosophies, and implementation issues. This course covers the following topics: systems architectures; processes; communication and synchronization paradigms; naming methods in distributed systems; consistency and replication; security and fault-tolerance; distributed file systems; forms of distributed systems (object-based, web-based, and coordination-based).

CPE 631: Parallel System Architectures (3 Hours)

The objective of this course is to introduce students to the modern parallel system architectures, their design principles, capabilities, and applications. The course covers the following topics: architecture and programming of parallel; Multi-core multiprocessors (SMP); Superscalar and VLIW processor architectures; Instruction and thread-level parallelism; Memory hierarchy; Distributed and shared memory parallel computers; Interconnection networks and new architecture trends.

CPE 632: Parallel and High-Performance Computing (3 Hours)

The objectives of this course are to introduce the foundations of parallel and high-performance computing, and to gain a hands-on knowledge of the fundamentals of parallel and high-performance programming. The course covers the following topics: Parallel computers taxonomy; Fundamental communication operations and performance metrics; Design and analysis of parallel algorithms with emphasis on sorting, matrix algorithms, and graph algorithms, search algorithms, and dynamic programming; Parallel programming paradigms; message passing programming; data parallel programming; and shared-address space programming in threads.

CPE 633: Data Intensive Computing (3 Hours)

The objective of this course is to enable students to analyze, design, and implement effective solutions for data-intensive applications with very large-scale data sets. This course covers the following topics: data acquisition and cleaning; exploratory data analysis; statistical modeling; algorithmic data processing; knowledge extraction; prediction and prescriptive analytics; infrastructure for data intensive computing; big-data architectures; data structures and algorithms for data intensive computation.

CPE 680: Advanced Computer Architecture (3 Hours)

The aim of this course is for students to gain expertise and deep knowledge in computer architecture. The course provides a strong foundation for students to understand modern computer system architecture and to apply these insights and principles to future computer designs. The course is structured around the three primary building blocks of general-purpose computing systems: processors, memories, and networks.

CPE 681: Advanced Computer Operating Systems (3 Hours)

The main objective of this course is to introduce students to advanced concepts and issues of computer operating systems. The course covers the following topics: File systems; I/O; Virtualization; Multiprocessor operating systems; security and protection; Implementation of file operations; Distributed operating systems; Recovery and fault tolerance; Kernel programming.

CPE 682: Systems Modeling and Simulation (3 Hours)

This course aims at empowering students with the necessary skills to model and simulate varying types of computer systems, and to evaluate system performance. The course covers several topics related to modeling and simulation of computer systems including mathematical modeling, state space modeling, structural modeling, behavioral modeling, stochastic modeling, computer-based model simulation, analysis of simulation results, performance evaluation, random number generation, commonly used distributions, and linear modeling.

CPE 690: Scientific Writing and Communication (2 Hours)

This course has several objectives, which are: increasing technical proficiency in scientific writing in all of its forms; promoting the concept of academic integrity and the ethics of scientific writing; promoting the concept of research collaboration and teamwork; enhance the ability orally present and defend a research proposal effectively; and familiarize students with the peer review process associated with research publications, grant proposals, and other academic manuscripts. The course instructs students in writing grant proposals, research proposals, theses, research manuscripts, reviews, as well as preparing scientific posters and giving effective oral presentations in their respective scientific fields.

CPE 691: Seminar (1 Hour)

This course aims at keeping students up-to-date with ongoing research their field of study. The course is, therefore, a research departmental seminar that addresses in depth recent research issues in one or more themes set a priori by the department.

CPE 692: Special Topics in Computer Engineering (3 Hours)

The objective of this course is to keep students up-to-date with recent and emerging research issues and advances related to computer engineering. The course addresses, in depth, a specific research topic in computer engineering selected by the department.

CPE 694: Graduation Project (3 Hours)

This course empowers students with hands-on experience in identifying applied problems, research their challenges and details, propose adequate solutions, implement proposed solutions, and finally evaluate the performance of implemented solutions. In this course, a student applies methodologies and techniques acquired in the area of the program to tackle research oriented real-life problems. Project topics are discussed and approved by the department graduate studies committee.