Department of Computer Science and Electrical Engineering

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Master of Science in Computer Engineering Description

The Master's degree in Computer Engineering is designed to prepare students for career advancement, or for further studies at the doctoral level. It has two options, thesis and professional (non-thesis). It is a research-based program of study, requiring students to complete independent research that culminates in several projects, and, in one of the options, with a thesis project. Either option includes rigorous curriculum and allows students to concentrate their program in the following specialized areas: Computer Architecture and Distributed Computing; Advanced Computer Networks; VLSI Circuit Design; Robotics, Artificial Intelligence, and Machine Learning.

Admission to the program requires a Bachelor's degree in computer engineering, electrical engineering or computer science from an accredited institution. Students not meeting this requirement will be considered for admission on an individual basis and may be admitted subject to the completion of appropriate undergraduate leveling courses to remove any deficiencies in preparation; in this case the department will recommend leveling courses, depending on the student's transcript.

Students must maintain a GPA of 3.0 or better, and make grades of C or better in all courses on the degree plan. No undergraduate courses can be counted towards this Master's degree. A maximum of 12 graduate credit hours may be transferred.

Master of Science in Computer Engineering

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Required Courses		
CPEN 5341	Advanced Algorithms	3
CPEN 5343	Advanced Computer Architecture	3
CPEN 5351	Introduction to Convex Optimization	3
CPEN 5355	VLSI Architectures	3
CPEN 5378	Advanced Computer Networks	3
CPEN Electives		6
Total Hours		**21**

Additional Required Courses for Concentrations

Thesis

Electives - 5000-level: ELEN, COSC, MATH, or BCIS		6
CPEN 5099	Thesis Research	6
Total Hours		**12**

Professional (non-thesis)

CPEN Electives		6
Electives - 5000-level: ELEN, COSC, MATH, or BCIS		9
Total Hours		**15**

Computer Engineering Courses

CPEN 5099. Thesis Research. 1-6 Credit Hours (Lecture: 1-6 Hours, Lab: 0 Hours).
Research for Master's thesis in Computer Engineering Prerequisites: Graduate standing.

CPEN 5341. Advanced Algorithms. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Amortized analysis, graph, network flow, string matching, matrix and polynomial algorithms, linear programming, NP-completeness, approximation algorithms, and an introduction to parallel algorithms. Prior knowledge or experience in data structures and algorithms recommended. Prerequisite: Approval of department head.

CPEN 5342. Parallel Computing and Algorithms. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Taxonomy of parallel computers, shared-memory and message-passing architectures, theoretical models; patterns and strategies for designing parallel algorithms; parallel data structures; automatic parallelization of sequential programs; communication; synchronization and granularity; applications. Prior knowledge or experience in Computer Architecture is recommended.

CPEN 5343. Advanced Computer Architecture. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
The course is structured around the three primary building blocks of general-purpose computing systems: processors, memories, and networks. Topics include the limitations of scalar pipelines, superscalar execution, out-of-order execution, register renaming, memory disambiguation, branch prediction, and speculative execution; multithreaded, VLIW, and SIMD processors; non-blocking cache memories, and memory synchronization, consistency, and coherence; multi-core, shared-memory architectures. The course also covers techniques for quantitative analysis of computer systems, to understand and compare alternative design choices. Prior knowledge or experience in Computer Architecture is recommended. Prerequisite: Approval of department head.

CPEN 5348. Advanced VLSI Circuit Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Analysis and design of key analog and mixed-signal IC blocks: analog switches, sampling circuits, switched-capacitor filters, ADCs, DACs, PLLs. Low-power design techniques and machine learning applications for analog and mixed-signal ICs. Prior knowledge or experience in Electronics II and Digital Signal Processing is recommended. Prerequisite: Approval of department head.

CPEN 5351. Introduction to Convex Optimization. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
This course introduces convex optimization problems, the basics of convex analysis, algorithms for convex optimization and their complexities, and applications of convex optimization. The course also trains students to recognize convex optimization problems that arise in scientific and engineering applications, and to use software tools to solve convex optimization problems. Prior knowledge or experience in Calculus III and Matrix Algebra is recommended. Prerequisite: Approval of department head.

CPEN 5355. VLSI Architectures. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
The course covers the most important methodologies for designing custom or semi-custom VLSI systems for typical signal processing and communications applications. Techniques for the inner and outer receiver, mapping of algorithms onto array structures, digital signal processing (DSP) systems, and field programmable gate arrays (FPGAs), programmable signal processors. Prior knowledge or experience in Computer Architecture is recommended. Prerequisite: Approval of department head.

CPEN 5361. Deep Neural Networks. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Introduction to the principles and theory of neural networks, with emphasis on deep neural networks. Topics include convolutional networks, recurrent and LSTM networks, reinforcement learning, preprocessing, regularization, tuning and optimization, as well as mathematical and programming tools. Applications to classification, image recognition, autonomous vehicles. Prior knowledge or experience in Data Science, Machine Learning is recommended. Prerequisite: Approval of department head.

CPEN 5366. Robot Vision. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
This course aims at bridging the gap between computer vision and deep learning. It covers topics such as object detection and recognition, machine learning algorithms for computer vision, and advanced techniques for 3D computer vision. Real world applications and projects will be implemented in the areas of autonomous vehicles and robotics. Prior knowledge or experience in Computer Vision, Python, and C/C++ programming is recommended. Prerequisite: Approval of department head.

CPEN 5377. Wireless and Mobile Communication Networks. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Advanced architectures for wireless communication networks; advanced wireless technologies; challenges and issues in designing such networks; queueing theory and other stochastic models. Prior knowledge or experience in Computer Networks or Communication Systems Theory, Probability, one semester of programming is recommended. Prerequisite: Approval of department head.

CPEN 5378. Advanced Computer Networks. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
This course concentrates on routing and inter-networking in IP networks, while addressing contemporary topics like wireless networks, security, voice and video over IP, the Internet of Things (IoT), software-defined networking, and network virtualization. Prior knowledge or experience in Computer Networks is recommended. Prerequisite: Approval of department head.

CPEN 5379. Performance of Computer and Communication Networks. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).
Application of probability, Markov chains, and queueing theory to the analysis and design of computer and communication networks. Case studies in traffic shaping and multiplexing, static routing, dynamic routing, and peer-to-peer file sharing systems. Both continuous-time and discrete-time models are explored. Prior knowledge or experience in Computer Networks or Communication Systems Theory, Probability is recommended. Prerequisite: Approval of department head.

Computer Science Courses

COSC 5330. Simulation. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).
Introduction to simulation with emphasis on simulation methodology, random number generation, time flow mechanisms, sampling techniques, and validation and analysis of simulation models and results. Simulation languages and their applications will be investigated. Prerequisites: MATH 1342, COSC 2341, and Graduate standing. Lab fee $15.

COSC 5360. Artificial Intelligence. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).
Introduces representations, algorithms and architectures used to build intelligent systems. Predicate calculus, state-space representation and search, heuristic search, knowledge-based problem-solving, symbol-based and connectionist machine learning, intelligent agents, robotics. Prerequisites: MATH 1342, COSC 2341. Lab fee $15.

Electrical Engineering Courses