# COMPUTER SCI & INFO TECHNOLOGY (CST)

**CST 403 - COMPUTER NETWORKING**
This is an introductory course on the design and analysis of computer networks. It covers Internet protocols, application layer protocols, routing, wireless communication, and basic network security problems.
Credits: 3
Course Notes: CST/CSIA 250 OR 236 REQUIRED RMEC students only.

**CST 405 - ALGORITHM DESIGN**
The main purpose of the course is to enhance students' algorithmic skills. Algorithmic problems, arising across the full range of computing applications, include the following two tasks. First, such a problem rarely arrives as a cleanly packaged, mathematically precise question. Therefore, we begin an algorithm design process with getting to a clean formulation of the problem. Then, based on the structure of the problem, we identify an appropriate algorithmic technique and use it to develop an efficient algorithm. Students will enhance their skills for both tasks by learning a wide variety of algorithmic problems in business, engineering, science, etc.
Credits: 3
Course Notes: Cst 280 and Math 245 both with a min grade C- required.

**CST 406 - BIG DATA**
Coverage of approaches and methods for very large-scale data collections (Big Data). Also covers the place of Big Data in society and in business including economic, social, ethical and cultural implications. Students will learn to use map-reduce workflows and Big Data tools such as the Hadoop ecosphere.
Credits: 3
Course Notes: Prerequisites: CST 250 or CST 365 or consent.

**CST 408 - ADVANCED ALGORITHMS**
We study the nature of computational problems, and the hierarchy of complexity classes. We design algorithms that cope with hardness using advanced methods of algorithm design: moderately exponential algorithms for hard problems, parameterized algorithms, incomplete methods for solving problems, finding approximate solutions for hard problems.
Credits: 3
Course Notes: CST 280 with a min grade of C- or concurrent.

**CST 410 - NETWORK SCIENCE**
The study of real-world networks such as social networks, technological networks, networks of information, biological networks. This study combines methods and techniques from mathematics, computer science, social sciences, and many other areas. Course topics include the measurement of networks, methods for analyzing network data, models of networks, models of processes taking place on networks, etc.
Credits: 3
Course Notes: Cst 280 and Math 245 both with a min grade C- required.

**CST 411 - INTELLIGENCE SYSTEMS**
Design and analysis of algorithms that perform tasks commonly regarded as requiring human intelligence. We study automated search methods in constrained state spaces. We learn methods of blind, heuristic and local search and methods that involve applications of mathematical logic. Our algorithms do inference, solve constraint satisfaction problems, do planning and scheduling. When needed they learn by implementing reinforcement learning. Applications to multiagent systems and robotics. In this course we program some of the systems that we study.
Credits: 3

**CST 412 - THEORY OF COMPUTATION**
Fundamentals of computing with emphasis on questions of what can and cannot be computed in principle, what can and cannot be computed efficiently. Course topics include models of computation, decidable and undecidable problems, computational complexity, probabilistic computation, interactive protocols, quantum computation, etc. Coursework includes an independent study component where students learn advanced topics in theory of computation.
Credits: 3
Course Notes: CST 280 with a min grade of C- required.

**CST 414 - IT MANAGEMENT**
The purpose of this class is to introduce the student to various topics concerning the job of the IT Manager. The goal of this course is to make you a more knowledgeable IT person who can better understand the roles and functions of the IT Manger in both small and large scale companies. For those of you who might wish to someday fill this role it is a way to learn the concepts before you find yourself in this positon. And for those of you who do not seek this position, it will give you a better idea on how to relate to and understand the IT Manager.
Credits: 3
Course Notes: For RMEC students only.

**CST 421 - DATA MINING**
Methods of knowledge discovery in massive datasets. We study methods of digging through and analyzing enormous data sets and then extracting the 'meaning' of the data by applying mathematical methods. The methods that we study in this course are designed to predict behaviors and future trends based on existing data. Topics include classifications techniques, clusterization techniques, techniques for improving data quality. The course has programming component.
Credits: 3
Course Notes: Prerequisites: MATH 246 and (MATH 217 or MATH 347 or ACSC 300 or ACSC 347 or ECON 234) and CST 150.

**CST 423 - GAME THEORY AND APPLICATIONS**
This course covers probabilistic and combinatorial games and games played by computer programs. Examples range from poker to battleship to voting systems to reinforcement learning. The course emphasizes real-life applications of game-theoretical techniques in areas as diverse as artificial intelligence, decision theory, economics, psychology, and finance.
Credits: 3
Course Notes: A grade of C- or better in Math/ASCS 300, and in Math 245 or Math 290, or Math 217, or Math 238, or Math 347. No additional credit for CST 423 as COOPERATION AND COMPETITON

**CST 427 - COMBINATORICS**
Permutations and combinations; identities involving binomial coefficients; inclusion-exclusion principle; recurrence relations; generating functions; introduction to the theory of graphs. See also Math 345.
Credits: 3
Course Notes: Math 232 and (Math 245 or Math 290) all with a min grade of C- required.

**CST 428 - LINEAR PROGRAM & OPTIMIZATIONS**
Models of optimization with linear constraints and objectives; simplex method and related algorithms; duality and sensitivity; transportation and assignment problems; games and network flow applications. See also Math 428.
Credits: 3
Course Notes: Math 122 with a min grade C- required.

**CST 435 - ETHICAL HACKING & COUNTERMEASU**
This is a hands-on Cyber Security course that will prepare students for the Certified Ethical Hacker certification. The course is an introduction to ethical hacking tools and incident handling. Areas of instruction include various security tools and vulnerabilities of operating systems, software and networks used by different type of hackers to access unauthorized information. This course also addresses incident handling techniques used when information security is compromised.
Credits: 3
Course Notes: CST 150 and MATH 116 or MATH 121 are required.

**CST 436 - COMPUTING WITH DATA IN PYTHON**
Using Python for data processing requires implementation of linear algebraic operations with vectors matrices and tensors. The new data structures reflecting these needs are data frames, multidimensional dynamic arrays, tensors, trees and hashes. This means learning new packages such as Pandas, Numpy, Scipy, Scikit-learn, and many more.
Credits: 3
Course Notes: Computer programming experience not required. Recommended prior courses: Math 246

**CST 444 - O.O.P & WEB SERVICES**
An intensive course in programming emphasizing the development of reusable software components via the object oriented programming (OOP) capabilities of C#. Topics include user interface controls, exception handling, classes, function overloading and default arguments, operator overloading, event-driven programming, polymorphism and UML. Extensive programming required.
Credits: 3
Course Notes: CST 250 with a min grade C-or CST 365 with a min grade C- required.

**CST 449 - ADVANCED COMPUTER ARCHITECTURE**
This course covers instruction set architecture, data path and control unit design, advanced computer arithmetic, pipelining, memory hierarchy and I/O subsystem, performance issues.
Credits: 3
Course Notes: Pre-requisites CST 261 or CST 317

**CST 455 - GRADUATE SEMINAR**
Course content varies. Study of the current state of research in a designated area of the computer science. A faculty member introduces initial study of the fundamentals, followed by the study of recent publications chosen by a faculty member.
Credits: 3

**CST 457 - SYSTEMS PROGRAMMING**
Introduction to programming at the system level. Programming methods and issues which are specific to working with the operating system. Topics include process, thread model, synchronous and asynchronous event handling, IPC, RPCs and sockets, and distributed applications. Course includes learning to program with JAVA in UNIX and Windows environments. A computer use course.
Credits: 3
Course Notes: Cst 250 or Cst 365 with a min grade C- required.

**CST 461 - DEEP LEARNING**
We study Artificial Neural Networks computing paradigm which are foundational models of natural language processing, image processing and generative AI. Staring with multilevel perceptron, we move on to Convolutional NN to Recurrent NN and finally to transformers. Along the way we study necessary mathematical foundations that include optimization methods, methods of learning theory and game theory; we program the networks in Python using TensorFlow, Torch, and Keras packages. A computer use course.
Credits: 3
Course Notes: Recommended prior courses: CST 236, CST 280, Math 231, Math 246

**CST 465 - NETWORK APPLICATIONS DEVELOPMENT**
Design and programming applications for networks and the World Wide Web; client side and server side processing; the use of a web browser as a client and user interface. Internet protocols such as https, ftp, and ssl and issues such as security, reliability, and management. Course includes programming with JAVA in UNIX and Windows environments. A computer use course.
Credits: 3
Course Notes: CST 150 with a min grade of C-.

**CST 466 - CRYPTOGRAPHY**
Cryptography provides algorithms and protocols for secure communication over an insecure channel. These tools are also used in many other aspects of information security such as access control or digital signature. Cryptography plays a crucial role in a wide scope of real-world applications, from the classical military and national security applications to email and online banking. The course focuses on concepts and techniques underlying public-key cryptography. Course topics include symmetric cryptosystems, RSA and other public-key cryptosystems, digital signatures, key exchange protocols, secret sharing, identification schemes, etc. Coursework includes an independent study component where students learn advanced topics in cryptography.
Credits: 3
Course Notes: CST 150 and MATH 245 with min. grade of C- or consent of the instructor.

**CST 467 - WEB-BASE DATABASE APPLICATIONS**
Interactive web-based applications that use one or several databases. Theoretical and project oriented.
Credits: 3
Course Notes: Any 200 level programming course with a min grade C- or CST 333 and CST 365 or CST 250 with a min grade C-.

**CST 468 - INTERNET SECURITY**
An in-depth study of Internet security focused on contemporary threats and countermeasures. A number of threats will be discussed including protocol vulnerabilities, denial of service attacks, malware, and other readily available hacking tools. The security mechanisms used to thwart these threats include firewalls, proxy servers, and other security techniques and tools
Credits: 3
Course Notes: Must have one course in Data Communication with a C- or higher or instructor's consent.

**CST 471 - DISTRIBUTED DATABASES**
Use of multiple, physically and logically separate databases. Data modeling, horizontal and vertical fragmentation, distributed query processing, concurrency, deadlocks, and recovery techniques. Heterogeneous and object-oriented databases. Functional languages like LISP and ML are studied as well as logic programming.
Credits: 3
Course Notes: 9 Credit Hours of Computer Sci. Min grade of C- required in prerequisite work.

**CST 475 - COMPUTER FORENSICS**
An introduction to the procedures and techniques used to identify, extract, validate, document and preserve electronic evidence. General legal issues such as the proper handling of evidence, chain of custody, and admissibility in court also covered. See also ACCT 475.
Credits: 3
Course Notes: Ability to download, install, and use basic computer applications software is assumed.

**CST 480 - SPECIAL TOPICS**
Course content varies. May be repeated for credit with different topics.
Credits: 1-3

**CST 485 - THESIS/PROJECT RESEARCH**
Planning and implementation of research component of student's MS thesis or project.
Credits: 3,6
Course Notes: Approval of CST thesis sponsor and Dept. Chair required. Must be taken in a semester prior to either CST 490 or CST 499.

**CST 486 - INFORMATION RETRIEVAL**
Theory and practice of information retrieval with emphasis on applications to web search. The course covers traditional information retrieval topics (retrieval models, indexing, classification, clustering, ranking of web pages, etc.) and more recent topics (such as interactions between information retrieval and natural language processing).
The course has programming component. Coursework includes an independent study component where students learn advanced topics in information retrieval.
Credits: 3
Course Notes: CST 280 with min grade C-

**CST 487 - SPECIAL TOPICS**
Credits: 3

**CST 490 - MASTERS THESIS**
Completion of the MS thesis.
Credits: 3
Prerequisites: CST 485
Course Notes: Approval of CST faculty sponsor and Dept. Chair.

**CST 493 - COMUPUTER SICENCE CPT INTERNSHIP**
This course allows international students to fulfill their CPT requirements for zero credits.
Credits: 0

**CST 494 - INTERNSHIP: COMPUTER SCIENCE**
Advanced in-service learning under faculty supervision.
Credits: 1-3
Course Notes: Consent of Faculty Supervisor required

**CST 499 - MASTERS PROJECT**
Completion of the MS project.
Credits: 3
Prerequisites: CST 485
Course Notes: Approval of CST faculty sponsor and Dept. Chair.

**CST 499Y - MASTERS PROJECT COMPLETION**
Continuation of the CST Masters Project.
Credits: 0
Prerequisites: CST 485
Course Notes: Approval of CST faculty sponsor and Dept. Chair. Students must register for this course if they fail to meet deadlines for completion of CST 499.

**CST 500 - FND COMPUTING**
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Credits: 3