

## **COMPUTER SCIENCE (CPTR)**

*NOTE: Students enrolling in computer science classes must receive at least a C grade in all its pre-requisite mathematics and computer science courses.*

### **301 NUMERICAL METHODS (3)**

Prerequisite: CPTR 241, MATH 261.

Numerical methods in problems in mathematics, including numerical integration and differentiation, calculation of roots, interpolation, numerical techniques in linear algebra, programming in either FORTRAN or PL/1. Additional course fee.

### **305 ASSEMBLY LANGUAGE PROGRAMMING /5 (3)**

Prerequisite: CPTR 241.

Assembly language and numbering system. Hardware and software architecture. Macro assembler, I/O services. Conditional processing Arithmetic processing. Subroutines. High-level language interface. Additional course fee.

### **307 DATA STRUCTURES /5(3)**

Prerequisite: CPTR 241 and MATH 283.

An introduction to data representations and data structures, followed by a detailed study of operations and applications with character strings (including character sorting, table searching, text editing), linearly linked lists, trees, and graphs. Additional course fee.

### **308 INTRODUCTION TO FILE PROCESSING (3)**

Prerequisite: CPTR 307.

Sorting, symbol tables, hash tables, sequential and random access of files, file organization, storage management. Additional course fee.

### **309 COMPUTER ALGORITHMS (3)**

Prerequisite: CPTR 307.

Design and analysis of algorithms. Searching, sorting, and combinatorial algorithms. Time and space complexity. Additional course fee.

### **310 COMPUTER GRAPHICS /5 (3)**

Prerequisite: MATH 163 or 171 and CPTR 241.

Among the topics covered are line-drawing algorithms, tables, clipping algorithms, techniques for motion, and other topics in two-dimensional graphics. Students are required to write programs implementing the techniques discussed. Some evaluation of graphics software may be done as well as an introduction to three dimensional graphics. Additional course fee.

### **313 OBJECT ORIENTED PROGRAMMING (3)**

Prerequisite: CPTR 241.

Classes, data encapsulation, inheritance, polymorphisms, OOD/OOP technologies, C++ and other OOP languages. Additional course fee.

**317 THEORY OF COMPUTATION (3)**

Prerequisites: Math 283 and a co-requisite of CPTR 307

Regular expressions and languages; finite-state machines; formal grammars; regular, context-free, context-sensitive, and unrestricted grammars; pushdown automata; context-free languages; Turing machines; Church's thesis; random-access machines; recursive functions; P-completeness problem; intractable problems. Additional course fee.

**320 PROGRAMMING LANGUAGES (3)**

Prerequisite: CPTR 307

Language syntax; lexical properties, BNF and parsing examples; language processors; compilers, interpreters and direct execution; language representations and language styles. Additional course fee.

**333 COMPUTER ORGANIZATION (3)**

Prerequisite: CPTR 305.

Introduction to hardware concepts of digital computation: logical design, data representation, and transfer. Digital arithmetic, input-output facilities, system organization. Additional course fee. Credit not given for both CPTR 333 and CPTR 303. IAI: CS 922.

**339 SOFTWARE ENGINEERING (3)**

Prerequisites: CPTR 241

Project management fundamentals; software design and development; software life cycle; tools for verification and validation software; software metrics, project estimation, testing methods and strategies; walkthrough and inspection; object-oriented software engineering. Additional course fee.

**340 SYSTEMS ANALYSIS AND DESIGN (3)**

Prerequisite: CPTR 241 or 250.

An introduction to the system development life cycle. Emphasis on strategies and techniques of system planning, analysis form and file design, documentation, implementation and evaluation. Additional course fee.

**341 MODELING AND SIMULATION (3)**

Prerequisite: CPTR 307 and MATH 210 or 315.

Simulation methodology, techniques of random number generation, discrete system simulation, simulation languages, model validation, and case studies. Additional course fee.

**355 INTRODUCTION TO OPERATION SYSTEMS (3)**

Prerequisite: CPTR 305 and 307.

Introduction to the basic components and functions of operating systems, resource management and performance evaluation. Writing emphasis course. Additional course fee.

**356 COMMUNICATION AND COMPUTER NETWORKS I (3)**

Prerequisite: CPTR 312 and 355.

Digital data flow and error control, multiplexing, switching architecture, satellite communication, network structure and topology, layering, protocols, interfaces, OSI reference model, IEEE 802 LAN. Writing emphasis course. Additional course fee.

### **357 INTRODUCTION TO DATA BASE SYSTEMS (3)**

Prerequisite: CPTR 307.

Database system architecture. Relational, hierarchical, network database models. Query languages and data definition languages. Security and system evaluation. Case studies. Additional course fee.

### **358 RELATIONAL DATABASE AND MANAGEMENT (3)**

Prerequisite: CPTR 357.

Relational data model. Normalization. SQL. Concurrent control. Query optimization. Emphasis in laboratory work including system development using a software package. Additional course fee.

### **362 NETWORK SECURITY (3)**

Prerequisite: CPTR 356

Computer systems, network, and data security; formal definitions of security, privacy, and integrity; risk assessment and management; establishing security policies; securing the infrastructure; perimeter security components; encryption technology overview; coding, cryptography, and crypto-analysis; authentication methods and digital signatures; network security management tools; malicious software (e.g. viruses and logic bombs); audit and control methods; legal factors; databases and inference controls; security kernels and verification methods; internet/intranet firewalls. Additional course fee.

### **365 NETWORK ADMINISTRATION (3)**

Prerequisites: CPTR 356

Simple network management protocol; structure and identification of management information bases; managing interfaces; address translation; IP addresses; ICMP, TCP, and UDP management; gateway protocol management; reporting SNMP traffic; managing the Ethernet; token ring; FDDI; PPP; X.25 and the frame relay interface; bridge management. Additional course fee.

### **366 COMMUNICATION AND COMPUTER NETWORKS II (3)**

Prerequisite: CPTR 356.

Local area network topology. Protocols. Access media. Client/server. Network management and trouble shooting. Novel network. TCP/IP. Open system. Emphasis in laboratory work. Additional course fee.

### **368 TCP/IP INTER-NETWORKING AND APPLICATIONS (3)**

Prerequisite: CPTR 355

The OSI model and TCP/IP protocol; TCP/IP architecture; IP addressing, subnetting, and routing. ARP and RARP address resolutions; internet control message protocol; user datagram protocol; routing protocols; application layer and client-server model; domain name system; file transfer protocol; simple mail transfer protocol; Telnet remote login; network security. Additional course fee.

### **370 SPECIAL TOPICS IN COMPUTER SCIENCE (1-3)**

Prerequisite: To be determined by instructor and consent of the department.

Computer science (mathematics) topics of current interest. May be repeated for credit with a different topic. Additional course fee.

**371 PATTERN RECOGNITION (3)**

Prerequisite: CPTR 307 and MATH 210 or 315.

Decision theory, parameter estimation, supervised learning, nonparametric methods, clustering, unsupervised learning, introduction to image processing. Additional course fee.

**372 INTRODUCTION TO ARTIFICIAL INTELLIGENCE (3)**

Prerequisite: CPTR 307 and MATH 303.

Problem representation, problem solving, game playing, knowledge representation and predicate calculus, resolution and refutation, expert systems, robot problem solving, AI languages (LISP and/or PROLOG). Additional course fee.

**381 COMPUTER SCIENCE INTERNSHIP (3-6)**

Prerequisite: Grade of C or higher in three 300-level computer science courses and earned eighty semester hours towards the bachelor of science degree and major in computer science; or consent of the department.

student project or activity in a computer science environment outside the Mathematics Department where the techniques of computer science are applied in an essential way. Activity to be performed must be in addition to the student's regular job, and must be approved in advance by the department. A written final report is required.

*Note: All graduate students are eligible to enroll for 400-level classes, except those designated as restricted to master's degree students or requiring departmental permission. Prior consultation with the department is recommended.*

**404 AUTOMATA THEORY, LANGUAGES, AND COMPUTATION (3)**

Prerequisite: CPTR 307, CPTR 317

Formal languages, finite-state control machine, regular expressions and languages, Turing machines, push-down automata, context-free languages, feasible problems, p-complete theory; basic recursive functions theory, computational complexity theory, intractable problems. Additional course fee.

**409 ALGORITHM THEORY AND ANALYSIS (3)**

Prerequisite: CPTR 307

The derivation of theoretical results and their application to designing of efficient algorithms. Topics include: algorithm verification and efficiency of sorting; tree structures, network problems, pattern matching. Additional course fee.

**420 ADVANCED SOFTWARE ENGINEERING (3)**

Prerequisite: CPTR 339

Provides a theory and a set of techniques that will help the software engineer build systems and applications of high quality. Topics include: managing software projects, project planning and metrics, methods and strategies, technical metrics for software, software reuse, re-engineering, CASE Tools, client/server software engineering. Additional course fee.

**424 SOFTWARE PROJECT MANAGEMENT (3)**

Prerequisite: CPTR 420

The development of models and tools to improve productivity and quality of the process. Topics include: Algorithmic cost estimation models and functions, risk analysis and management, CASE tools applications to project management, object-oriented concepts applied to management, management of software reuse and maintenance, software capability maturity model. Case studies. Additional course fee.

**429 SOFTWARE MEASUREMENT AND RELIABILITY (3)**

Prerequisite: CPTR 339; MATH 210 or 315

Modeling of software and systems reliability, techniques for prediction, analysis and recalibration of software, best current practice of SRE, measurement-based analysis of software reliability, software complexity and software quality, software testing and reliability, fault-tolerant software reliability engineering, software reliability simulation, neural networks for software reliability engineering, software reliability tools. Additional course fee.

**430 COMPUTER SYSTEM ARCHITECTURE (3)**

Prerequisite: CPTR 303

Fundamentals of computer design, instruction set architecture, pipeline architecture and instruction-level parallelism, memory-hierarchy design, instruction execution and synchronization, micro-operations, vector and parallel processors, storage systems, multi-processors, RISC architecture. A term project involving the design and implementation of a model computer. Additional course fee.

**440 ADVANCED DATABASE DESIGN AND IMPLEMENTATION (3)**

Prerequisite: CPTR 357

Functional dependencies and normalization for relational databases, practical database design and tuning, query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques, database security and authorization, enhanced data models for advanced application. Additional course fee.

**445 OBJECT-ORIENTED DATABASE (3)**

Prerequisite: CPTR 357

Object-oriented data models, query languages, the ORION Model: its evolution and authorization, query processing, storage management and indexing techniques, object-oriented database systems. Additional course fee.

**446 DISTRIBUTED DATABASE SYSTEMS (3)**

Prerequisite: CPTR 357

Distributed database concepts, techniques, and types, data fragmentation, replication, and allocation techniques for distributed databases, query processing and languages, concurrency control and recovery, client-server architecture and its relationship to distributed databases, the ORION model. Additional course fee.

**447 DATA WAREHOUSING AND DATA MINING (3)**

Prerequisite: CPTR 357

Principles, concepts, and physical and logical architecture of data warehousing, risk, failures, infrastructure, and design techniques, creating and unlocking the data asset for end users, designing and implementing business information warehouses, data warehouse physical structure, methodology, organization, and management. Additional course fee.

**460 ADVANCED OPERATING SYSTEMS (3)**

Prerequisites: CPTR 355

Review of a standard operating system source code. Topics include: Memory management, process management, inter-process coordination and synchronization. Writing, modifying, and implementing operating system source code constitute a significant part of the course. Additional course fee.

**461 NETWORK OPERATING SYSTEM DESIGN (3)**

Prerequisite: CPTR 460

Continuation of CPTR 460. Additional topics include telecommunication and networking operating system principles and coding. Course fee

**464 ADVANCED TCP/IP NETWORK ARCHITECTURE (3)**

Prerequisite: CPTR 368 and 460

An advanced study of the architecture principles and mechanisms required for the exchange of data. Topics include: architecture, access protocols, inter-working, transport and presentation protocols, simple network management protocol, management information bases, managing interfaces, managing the exterior gateway protocol. Additional course fee.

**469 ADVANCED NETWORK SECURITY AND PRIVACY (3)**

Prerequisite: CPTR 362

Network security practice, electronic mail security, IP security, web security, network services attacks methods, auditing and detection, Internet and intranet firewalls, firewalls design and implementation, security policy, proxy servers, firewall architectures, maintenance and tools. Case studies and projects about cryptography and network security. Additional course fee.

**492 GRADUATE SEMINAR (3)**

Prerequisite: Twenty-one graduate-level credit hours in computer science and consent of department.

Conducted by graduate faculty of the department. The course may be repeated under a different topic with the permission of the department. Additional course fee.

**495 THE GRADUATE COMPUTER SCIENCE EXPERIENCE (3)**

Prerequisite: Twenty-one graduate-level credit hours in computer science, including all the other required core courses, consent of department.

An individualized computer science course which is normally among the last courses taken by master's candidates. The content is variable and may be a thesis, an expository paper, a project, a historical paper, a field experience in computer science, or other acceptable topic. Additional course fee.