**CMPE 516 Advanced Topics in Microprocessors (3 / 0) 3**
Microprocessors: CISC and RISC microprocessor concepts, Intel family of microprocessors: Addressing and memory, segmentation and protection mechanisms, multitasking, virtual memory, and exceptions, Pentium architectures, Motorola family of microprocessors: The user programming model, the supervisor state, microprocessors and floating-point arithmetic RISC architectures: IBM RISC chips, MIPS microprocessors, the SPARC architecture, the INMOS transputer, the future of microprocessor design.

**CMPE 521 Advanced Computer Architecture (3 / 0) 3**
Parallel processing models, parallel and distributed processor technology, interconnection schemes, bus organizations, pipelining, threads, multiprocessor and multi-computer systems.

**CMPE 522 Distributed Shared Memory Multiprocessing (3 / 0) 3**
Parallel shared memory multiprocessor systems, cache coherence, scalability, shared-memory parallel programs, memory latency, DASH and other experimental systems.

**CMPE 523 Parallel and Distributed Programming (3 / 0) 3**
Types of parallel systems and their peculiarities, approaches for programming supercomputers using various versions of FORTRAN language, OCCAM and ANSI C languages for transputer systems, C and Assembler languages for parallel neuroprocessor, using of parallel constructions in Win32 operating systems, using of parallel programming in the distributed environment on the base of CORBA, DCOM approaches for Win32 and PVM for Unix.

**CMPE 531 Logic Programming (3 / 0) 3**
Declarative Prolog programming, unification and resolution, backtracking, cut and fail, non-determinism, representation of data structures, meta-programming, constraint-logic programming, parallel Prolog.

**CMPE 533 Artificial Intelligence (3 / 0) 3**
The Turing Test, survey of AI, problem solving and search strategies, informed and uninformed search algorithms, game playing, knowledge representation methods, inference and logical reasoning, uncertain knowledge and reasoning, learning, knowledge in learning, learning in neural and belief networks.

**CMPE 534 Automated Deduction (3 / 0) 3**
This course is about automatically (and mechanically) proving theorems in first order predicate calculus. Introduction to propositional logic, predicate calculus and proof methods. Herbrand's theorem. The resolution principle (in its various forms) as the theoretical background for the programming language Prolog. Paramodulation, term rewriting systems and e-unification under equational logic. Applications of automated reasoning.

**CMPE 535 Knowledge Engineering (3 / 0) 3**
An overview of AI, Knowledge-based systems - a survey, Knowledge Engineering concepts; Human Problem Solving, Human Information Processing System, Cognition Models; Knowledge Acquisition; Knowledge Representation, Production Rules; Inference, Forward Chaining, Backward Chaining, Mixed Chaining; Uncertainty, Certainty Factors, Bayesian, Fuzzy set based and Dempster-Shafer methods; Automated Knowledge Acquisition, Machine Learning Approaches in Expert Systems, Rule and Decision-Tree Induction; Connectionist expert systems; Expert System Building Tools,
Development languages, Shells, Environments; Expert system design using rule-based shells; Expert system development life-cycle; Blackboard architectures; Truth Maintenance Systems.

CMPE 536 Metaheuristics (3 / 0) 3
Heuristics and meta-heuristics, neighborhood search, local and global optimization, simulated annealing, greedy randomized adaptive search, tabu search, evolutionary algorithms, ant-colony optimization, Lagrangean relaxation, hybrid methods, performance evaluation of meta-heuristics.

CMPE 539 Multiagent Systems (3 / 0) 3

CMPE 541 Networks and Distributed Systems (3 / 0) 3

CMPE 543 Operating Systems Theory (3 / 0) 3
Operating system concepts, functions of operating systems, centralized and distributed operating systems, operating systems for multiprocessor systems.

CMPE 544 Network Operating Systems (3 / 0) 3
Basic concepts of network operating systems and distributed operating systems, Windows NT and 2000 networking services, networking in UNIX, network API’s, network protocols.

CMPE 545 Broadband Networks (3 / 0) 3
Markov queues and their applications, M/G/1 queues, network of queues, traffic characterization in ATM networks, traffic management in ATM networks, ATM switch architectures, ATM multiplexer modeling, routing and flow control, wireless ATM.

CMPE 546 Advanced Information Structures (3 / 0) 3
Advanced data structures, strings in information systems, applications of linked lists, trees and their applications, complex graph structures, dynamic storage management, advanced sorting and searching techniques.

CMPE 547 Queuing Networks for Computer Applications (3 / 0) 3
Basic probability and statistics overview, transforms, discrete and continuous time Markov chains, steady-state solutions of Markov chains, queuing systems, queuing networks and their applications in
computer systems.

**CMPE 548 Analysis of Computer Communication Networks (3 / 0) 3**
Advanced topics in communication networks. Topics include Markov processes, renewal theory, queues, stochastic networks, network calculus, routing and congestion control, utility functions, max-min and proportional fairness.

**CMPE 574 Biometrics (3 / 0) 3**
Introduction to biometrics, person recognition, modules of biometric systems, biometric functionalities: verification and identification, biometric system errors and performance measures, the design cycle of biometric systems, applications of biometric systems, face recognition, iris recognition, fingerprint recognition, additional biometric traits, introduction to multibiometrics
CMPE 549 Wireless Personal Communications (3 / 0) 3
Wireless communication, mobile analog cellular telephony, GSM: channels, messages, mobility management, handoff issues, data and multimedia communication over mobile systems, recent advances in mobile systems, wireless ATM.

CMPE 551 Database Theory (3 / 0) 3
Predicate calculus, first-order logic, relational databases: representation, updating, querying, completeness, model theory, proof theory, incomplete and deductive databases.

CMPE 552 Database and File Security (3 / 0) 3
Confidentiality, discretionary security, multilevel security, security levels, Trojan horse, covert channel.

CMPE 553 Cryptography and Network Security (3 / 0) 3

CMPE 561 Neural Networks (3 / 0) 3
Human brain and biological neurons, artificial neuron models, the perceptron and the perceptron learning algorithm, the least-mean square algorithm, multilayer networks and the backpropagation algorithm, unsupervised and reinforcement learning, growth algorithms, Hopfield networks and other recurrent networks, simulated annealing, the Boltzmann machine, self-organizing systems.

CMPE 562 Pattern Recognition (3 / 0) 3
An introduction to probability and random variables, feature vectors, pattern classes, decision rule, discriminant function, Bayes decision rule, Bayes discriminant functions, minimum error classification, linear discriminant functions and their training, parametric classification, maximum likelihood estimation, Bayesian parameter estimation, clustering techniques, multiple classifier systems.

CMPE 574 Biometrics (3 / 0) 3
Introduction to biometrics, person recognition, modules of biometric systems, biometric functionalities: verification and identification, biometric system errors and performance measures, the design cycle of biometric systems, applications of biometric systems, face recognition, iris recognition, fingerprint recognition, additional biometric traits, introduction to multibiometrics.

CMPE 575 Optimization Techniques in VLSI Design (3 / 0) 3
VLSI design models, logic synthesis and verification, test generation and fault simulation, the layout problem and circuit layout, circuit partitioning, placement, assignment, and floor planning, global routing and area routing, compaction.

CMPE 576 Advanced Systems Simulation (3 / 0) 3
Systems and their models. Analytical and simulation modeling. Structure of a discrete event simulation algorithm. Randomness in simulation. Queuing systems. Simulation languages and
tools. Extended Petri Nets for simulation. Simulation experiments. Statistical processing of output results of simulation.

CMPE 581 Modeling Multimedia Systems (3 / 0) 3
Digital representations of multimedia information, multimedia devices and system architectures, interactive and distributed multimedia systems, programming environments, timed-automata and petri-ts, temporal synchronization models for multimedia systems, timed extensions of HTML, SMIL.

CMPE 582 Object-oriented Prog. and Graphical User Interfaces in Java (3 / 0) 3
Structure of Java language, object-oriented aspects of Java, comparison of Java and C, programming exercises and projects on graphical user interfaces and animation in Java language.

CMPE 583 Web Semantics (3 / 0) 3
Course will cover URI scheme; XML and processing; resource description framework (RDF): model, syntax, schema and languages; ontology concept, Web-based ontologies, integration and interoperability, semantics and abstract syntax of OWL, DAML; semantic grid concept and applications; Web services and agents; best practice case studies; W3 Consortium, current activities and future directions.

CMPE 584 Evolutionary Computation and Programming (3 / 0) 3

CMPE 586 Software Implementation of Fuzzy Systems (3 / 0) 3
Uncertainty, imprecision and vagueness, fuzzy sets and systems, membership function design, inference principles and techniques, approximate reasoning, possibility distributions, fuzzy systems as universal approximators, fuzzy software packages, research fields in fuzzy theory.

CMPE 588 Engineering Semantic Web Information System (3 / 0) 3
Course introduction, survey of interest area; Semantic Web, RDF; OWL: syntax & semantics, leads; Semantic annotation; ontology construction and tools; Ontology evolution and translation; Reasoning with ontologies; Reasoner tools and use in info systems; Ontologies for knowledge management; Semantic information access; Semantic query languages; Semantic technology application case; Semantic Web services: methods and usage; Semantic Web applications study; Semantic SOA architecture; innovative applications; future directions.

CMPE 599 Special Topics in Computer Engineering (3 / 0) 3
Recent advances in selected topics in computer engineering will be examined. The specific topic(s) and the contents of the course will be determined and announced by the department at the beginning of each semester.