

Evolution of courses in logic design and switching theory

Year	201L	452	552	576	652
53-55			Introduced EE552 DIGITAL COMPUTING DEVICES -- General properties of digital computers; mathematical theory of design; gates, flip-flops, magnetic drums, storage tubes.		
57-58			EE552 modified to read EE552ab DIGITAL COMPUTERS -- Switching algebras (Boolean algebra). Circuits which perform arithmetic and control functions digitally ; computer organization, memory systems ; introduction to programming . Experience in operating a digital computer .		
61-62		Introduced EE452 DESIGN OF ANALOG AND DIGITAL COMPUTERS -- Design of digital and analog computers from a block diagram viewpoint, including elements of logical design and coding.			
64-65		Modified EE452 to read INTRODUCTION TO ANALOG AND DIGITAL COMPUTER DESIGN -- Analog computer programming; machine language programming of digital computers; design from a block diagram viewpoint; switching theory; example problems on digital and analog computers.	Modified EE552ab to read LOGICAL DESIGN OF DIGITAL COMPUTERS -- Switching theory; digital computer logical design; real time computing systems; analog-digital conversion; digital differential analyzers and other special purpose computers; computer software development.		Introduced EE652 SEMINAR IN COMPUTER THEORY -- Logical design, artificial intelligence ; patterns recognition ; computer control of industrial processes.
67-68		EE452 INTRODUCTION TO DIGITAL SYSTEM DESIGN -- Switching theory; logical design of digital computers; digital differential analyzers and other special purpose computers.	EE552ab THEORY AND DESIGN OF DIGITAL MACHINES -- Switching theory; digital computer logical design; digital differential analyzers and other special purpose computers; asynchronous sequential machines; Turing machines.		
69-70		EE452 INTRODUCTION TO LOGICAL DESIGN OF DIGITAL COMPUTERS -- Digital logic, Karnaugh map minimization, number systems, digital arithmetic, state devices, basic analysis and synthesis, and introduction of digital subsystems.			
71-72	Introduced EE201L INTRODUCTION TO DIGITAL CIRCUITS -- Switching algebra; formulation and synthesis of switching functions; realization of logical circuits using relays and solid state devices; clocked sequential circuits, counters, shift registers, adders. (Very similar to EE452)	EE452 Modified to be the old 552a	EE552 Modified to be the old 552b	Introduced EE576 SWITCHING AND AUTOMATA THEORY -- Structure theory of sequential machines; transition systems and regular expressions; Turing machines; machine decomposition, cellular automata; failure-tolerant system design.	
73-74		EE552 THEORY AND DESIGN OF DIGITAL MACHINES -- Abstract algebra; properties of switching functions, functional decomposition, multioutput, multilevel network synthesis; analysis, minimization, state assignment, synthesis of sequential machines; general purpose digital computer design.			

How to read these charts: Most courses are color-coded. A hashed entry for some year means that the courses has not yet been offered. A solid entry with no text indicates that the courses is essentially the same as last described. Bold face terms in course descriptions indicate new topics probably not taught previously.

Logic design and switching theory *continued*

Year	101/102L	201L	452	552
83-84	<i>Introduced</i> EE101/102L INTRODUCTION TO DIGITAL LOGIC -- Boolean algebra; number systems; binary arithmetic; codes; gates; Boolean expressions; Boolean switching function synthesis; iterative arrays; sequential machines; state machines; flip-flops; sequential circuits; simple processors.	EE201L INTRODUCTION TO DIGITAL CIRCUITS -- Advanced logic design; case studies; finite state machines controllers-hardwired and microprogrammed; MSI/LSI devices; timing, loading, clocking, optimization; design tradeoffs; lab experiments.		EE552 LOGIC DESIGN AND SWITCHING THEORY II -- State minimization of incompletely specified sequential circuits; asynchronous sequential circuits; races; state assignments; combinational and sequential hazards in logic circuits.
05-06	EE102L modified to read EE201L INTRODUCTION TO DIGITAL CIRCUITS -- Digital system design and implementation using discrete ICs and FPGAs; synchronous design of datapath and control units; state machine implementation methods; timing analysis; lab experiments, logic analyzers; schematic-entry and simulation; semester-end project.			
07-08		EE552 modified to read ASYNCHRONOUS VLSI DESIGN -- Asynchronous channels and architectures ; implementation design styles; controller synthesis; hazards, and races; Petri-nets ; performance analysis, and optimization; globally asynchronous locally synchronous design .		

Evolution of courses in digital design

Year	478	479L	454L	459L	560L
64-65	Introduced EE478 PULSE AND DIGITAL CIRCUITS -- Design of wave shaping circuits; transistor nonlinear models; design of linear sweeping circuits, electronic gates , multistable circuits ; negative resistance circuits.				
67-68*	Introduced EE479L PULSE AND DIGITAL CIRCUITS LABORATORY -- Experimental work related to EE478. Advanced switching circuits, pulse and digital systems, computer aided circuit design .				
80-81		Introduced EE454L INTRODUCTION TO SYSTEMS DESIGN USING MICROPROCESSORS -- Microcomputer processing and programming ; microprocessor organization and technology; applications of microprocessors; student group design project in microprocessor laboratory including system design, implementation, and debugging.		Introduced EE560L ADVANCED MICROCOMPUTER-BASED DESIGN -- Advanced design projects using the microcomputer laboratory: multiprocessor design, microprogramming systems, fault-tolerant computers, graphics systems, voice recognition and synthesis, process control.	
92-93		Introduced EE459L SENIOR DESIGN PROJECT -- Design, implementation and test of a computer hardware project; architecture, I/O interfaces, application specific hardware; presentation and demonstration.			
00-01		Modified EE560L to EE560 DIGITAL SYSTEM DESIGN-TOOLS AND TECHNIQUES -- ASIC design , FPGAs, VHDL , Verilog , test benches, simulation, synthesis, timing analysis, post-synthesis simulation, FIFOs, handshaking, memory interfaces, PCI bus protocols, CAD tools, design lab exercises.			
05-06		EE459 modified to read EE459L EMBEDDED SYSTEM DESIGN LABORATORY -- Specification, design, implementation, testing and documentation of a digital system project using embedded processors, programmable logic; analog I/O interfaces and application specific hardware.			
*1971	EE partitioned into two entities and most circuit related classes now fall under EE-EP				

Analog and hybrid computation

Year	453	553/a/b	554	654
55-57	Introduced EE553 ANALOG COMPUTERS -- Electrical analog of physical systems; active and passive circuit analogies; synthesis of transfer functions with operational amplifiers; function generation; scaling; computer utilization.			
57-58	EE553 modified to read EE553ab ANALOG COMPUTERS -- Computing elements; setting up problems; problem scaling and checking, input-output devices, function generators, and methods of representing nonlinearities.			
59-60	Introduced EE554 INCREMENTAL ELECTRONIC COMPUTERS -- Integration by numerical means to solve differential and algebraic equations; digital differential analyzers in industrial control. Computer available for class use.			
64-65	EE553 modified to read ANALOG COMPUTATION -- Electronic analog solutions of linear and nonlinear problems; repetitive computers; iterative techniques; analog storage; implicit techniques, gradient methods and applications, error analysis of computer solutions		EE554 modified to read HYBRID COMPUTATION -- Hybrid analog-digital computer systems. Applications to the solution of partial differential equations; system identification and optimization problems; random process studies; adjoint techniques; mathematical programming problems.	
67-68	EE553 again modified to read ANALOG AND DIGITAL COMPUTATION -- Analog and digital solution of linear and nonlinear problems; iterative techniques; analog storage; implicit techniques, gradient methods and applications, error analysis of computer solutions.			
69-70	Introduced EE453 INTRODUCTION TO ANALOG AND DIGITAL COMPUTATION -- Introduction to analog computer programming, amplitude and time scaling, function generation, digital computer solutions of differential equations, linear and nonlinear simultaneous equations, linear programming.		Introduced EE654 ADVANCED TOPICS IN ANALOG AND DIGITAL COMPUTATION -- Effect of computer structures on methods for the solution of engineering problems, application oriented languages , modeling, identification, systems simulation, sensitivity analysis, related topics.	
71-72	EE453 INTRODUCTION TO COMPUTATIONAL TECHNIQUES -- Numerical solutions to nonlinear algebraic and transcendental equations; matrix methods; systems of linear equations; numerical integration; digital and analog computer solutions of differential equations; simulation.	EE553 COMPUTATIONAL SOLUTIONS OF OPTIMIZATION PROBLEMS -- Computer algorithms for system optimization; search techniques, gradient methods, parameter optimization in control systems; optimization with constraints; linear and nonlinear programming; random search techniques.	EE554 REAL TIME SYSTEMS -- Hardware and software problems associated with interaction of digital computers with continuous processes; application to process control, hybrid computers, and data acquisition.	

Computer architecture and systems

Year	357	457/L	557/a/b	657	532
69-70			<p><i>Introduced EE557</i> DIGITAL SYSTEM ARCHITECTURE -- Computational algorithms, look-ahead and parallel processing, read-only and associative memories, memory organization and system design, reliability and redundancy, special purpose computers.</p>		
72-73		<p><i>Introduced EE457</i> INTRODUCTION TO COMPUTER ARCHITECTURE -- Computer organization; microprogramming, microprogram control; synthesis; addressing and instruction sequencing; interrupts; channel controller, minicomputers; comparison of various computers; super computers; parallelism, distributed logic.</p>			
74-75		<p>EE557ab DIGITAL SYSTEM ARCHITECTURE -- <i>a</i>: Basic machine organization; operating systems; addressing techniques; memory organization; instruction sets; microprogramming, parallelism; channels and controllers. <i>b</i>: Advanced concepts in parallel processing. Survey of various classes of processors such as minicomputers, classical stack, associative, array, and high level language processors.</p>			
83-84	<p><i>Introduced EE357</i> BASIC ORGANIZATION OF COMPUTER SYSTEMS -- Organization and operation of the processor, memory and I/O of a minicomputer at the machine language level; assembly language programming; data representation and computer arithmetic.</p>	<p>EE457 modified to read EE457L Computer systems organization -- Register transfer level machine organization; CPU data paths and control; microprogramming; timing, simple arithmetic units; basic I/O organization; design using register transfer languages in Lab.</p>		<p><i>Introduced EE657</i> PARALLEL PROCESSING -- Array processors, multiprocessors, pipeline processors; data flow computers; VLSI architectures; parallel numerical and non-numerical algorithms; mapping algorithms onto computer structures.</p>	
03-04			<p><i>Introduced EE532</i> WIRELESS INTERNET AND PERVASIVE COMPUTING -- Wireless Internet access technologies, 3G cellular systems, WAP and PKI protocols, mobile computing devices, network security for mobile E-commerce, software and middleware for pervasive, cluster, grid, and Internet computing.</p>		

Computer architecture and systems

Continued

Year	Advanced special topics	
85-86	<p><i>Introduced</i> EE656 FAULT TOLERANT COMPUTING SYSTEMS -- Fault classification, measures of reliability, modeling and evaluation. Detection and recovery schemes; case studies of recent designs. Reliability analysis of networks and distributed systems.</p>	<p><i>Introduced</i> EE659 INTERCONNECTION NETWORKS -- Theory, design and analysis of interconnection networks for multiprocessor systems. Study of regular, Omega, binary n-cube, Delta, Gamma networks; control algorithms; mapping algorithms to architectures.</p>
87-88	<p><i>Introduced</i> EE653 DATA-FLOW COMPUTERS AND FUNCTIONAL PROGRAMMING -- Programmability of general purpose multiprocessors systems, functional programming, data-flow multicomputers, existing prototypes, fault-tolerance.</p>	
92-95	<p>EE649 modified to read APPLIED PERFORMANCE EVALUATION OF COMPUTER SYSTEMS -- Performance evaluation techniques for hardware/software system design, capacity planning, system tuning and equipment procurement. Techniques include workload characterization and analytical models.</p> <p>Modified EE653 to read MULTITHREADED ARCHITECTURES, DATA-FLOW COMPUTING AND FUNCTIONAL PROGRAMMING - - Programmability of general purpose multiprocessor systems, functional programming, data-flow and multithreaded computers, existing prototypes, fault-tolerant issues.</p> <p><i>Introduced</i> EE661 PARALLEL KNOWLEDGE PROCESSING -- Parallel approaches to knowledge representation and reasoning. Topics range from the analysis of parallelism to the design of special purpose computer systems.</p>	

VLSI design

Year	477	577/a/b	677	582
82-83		<i>Introduced EE577</i> VERY LARGE SCALE INTEGRATION (VLSI) -- Circuit characteristics of metal oxide semiconductor devices; logic families; limits of technology. System architectures , timing, highly concurrent systems. Computer-assisted design. Applications. Chip design project.		
93-94		Modified EE577 to EE577ab VLSI SYSTEM DESIGN. EE577a -- Integrated circuit fabrication ; circuit simulation; basic device physics; simple device layout ; structured chip design ; timing; project chip; MOS logic ; system design silicon compilers . EE577b -- VLSI design project; preparation of chips for fabrication; testing fabricated chips ; design examples; design of specific units (e.g. buses); design techniques; system integration.		
94-95		<i>Introduced EE677</i> VLSI ARCHITECTURES AND ALGORITHMS -- VLSI models ; measures of area ; volume and time ; mapping algorithms ; systolic arrays ; area time tradeoffs; application to signal and image processing problems.		
96-97		<i>Introduced EE477L</i> MOS VLSI CIRCUIT DESIGN -- Analysis and design of digital MOS VLSI circuits including area, delay and power minimization. Laboratory assignments including design, layout, extraction, simulation and automatic synthesis.		
95-96		<i>Introduced EE582</i> TECHNICAL SEMINAR ON VLSI DESIGN -- VLSI design topics; packaging ; design; multiple-chip modules ; field-programmable gate arrays; thermal analysis ; advanced technologies; fabrication; high speed circuitry; commercial CAD/CAE packages.		

CAD and testing

Year	581	556/580/658/680/681	
69-70		Introduced EE556ab DESIGN AUTOMATION OF DIGITAL COMPUTERS -- Computational algorithms and heuristic procedures for simulation , logic design, implementation, and diagnosis of digital computers.	
74-75		EE 556a became EE556 DIAGNOSIS AND RELIABLE DESIGN OF DIGITAL SYSTEMS -- Test generation for combinational and sequential circuits, checking experiments, gate level simulation, easily diagnosable and fault tolerant system level design procedures, specific system studies.	EE556b became EE580 DESIGN AUTOMATION OF DIGITAL SYSTEMS -- High-level computer design languages and their applications in logic design and verification of digital systems; physical packaging, partitioning, assignment, placement, interconnection problems.
83-84		EE556 modified to read EE658 DIAGNOSIS AND DESIGN OF RELIABLE DIGITAL SYSTEMS -- Fault models; test generation; fault simulation; self-checking and self-testing circuits; design for testability; fault tolerant design techniques; case studies.	EE580 modified to read EE680 COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS -- Synthesis; partitioning; placement; routing of digital circuits; integrated circuit design methods; simulation at the switch, gate, register transfer and system levels.
94-95		EE680 expanded into EE680 and EE681 EE680 COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS I -- Synthesis, partitioning; placement; routing of digital circuits; integrated circuit design methods; simulation at the switch, gate, register transfer and system level.	EE681 COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS II -- Theory and techniques for design and analysis of digital logic; specifications and formal models; hardware-descriptive models; formal verification; high level synthesis; logic synthesis.
07-08		Introduced EE581 MATHEMATICAL FOUNDATIONS FOR COMPUTER-AIDED DESIGN OF VLSI CIRCUITS -- Mathematical techniques employed in computer-aided-design systems, including: graph theory, algorithmic and heuristic techniques for combinatorial problems, data structures and modeling.	

Networks

Year	449	549	550	649	650
78-79	Introduced EE550 COMMUNICATION NETWORK DESIGN -- Overview of computer communication networks: technologies and techniques. Design issues, capacity assignment, flow assignment, topological design, buffer allocation, routing, and flow control.				
80-81	Introduced EE549 ANALYTIC METHODS IN COMPUTER SYSTEM MODELING -- Queueing theory and its applications to performance modeling of computer systems; models of time sharing, scheduling, memory management, and resource sharing.				
82-83	Modified EE549 QUEUEING THEORY FOR PERFORMANCE MODELING OF COMPUTER SYSTEMS -- Review of Markov chains and simple queueing theory; advanced queueing theory; approximations, open and closed networks of queues; computational techniques; priority queueing; scheduling.		Modified EE550 DESIGN AND ANALYSIS OF COMPUTER COMMUNICATION NETWORKS -- ISO/OSI reference model; performance models of communication networks; network design; protocols; virtual circuits/datagram; routing, congestion control, flow control; local networks; satellite protocols; broadcasting networks.		
83-84	Introduced EE449 COMPUTER SYSTEM MODELING TECHNIQUES -- Discrete mathematics for modeling computer systems; set theory; relations; graphs; networks; combinatorics; probability and applications to reliability and performance modeling; simple queueing theory.		Introduced EE649 PERFORMANCE EVALUATION OF COMPUTING SYSTEMS -- Performance modeling; measurement and evaluation techniques; CPU scheduling disciplines; queueing network models; aggregation and decomposition; approximate queueing network models; memory hierarchies; memory interface; reliability models.	Introduced EE650 ADVANCED TOPICS IN COMPUTER NETWORKS -- Protocol modeling; flow and congestion control, dynamic routing, distributed implementation; broadcast communication media and multiple access protocols; local networks, satellite networks, terrestrial radio networks.	
87-88	Modified EE550 to read DESIGN AND ANALYSIS OF COMPUTER COMMUNICATION NETWORKS -- Applications of stochastic modeling an optimization techniques to communication network design and analysis. Data link control; performance models; multi-access channels; routing and control flow.				

Networks *continued*

Year	465	555	579	652	
94-95	<p><i>Introduced EE555</i> BROADBAND NETWORK ARCHITECTURE -- ATM and BISDN, switch designs, high speed local, campus and metropolitan area networks; lightwave and photonic networks; network management techniques, applications and gigabit network applications.</p>				
91-92	<p><i>Introduced EE465</i> PROBABILISTIC METHODS IN COMPUTER SYSTEMS MODELING -- Review of probability; random variables; stochastic processes; Markov chains; and simple queueing theory. Applications to program and algorithm analysis; computer system performance and reliability modeling.</p>				
04-05	<p><i>Introduced EE579</i> WIRELESS AND MOBILE NETWORKS DESIGN AND LABORATORY -- Mobil ad hoc networks: ad hoc and geographic routing, resource discovery, medium access control, IP-mobility, mobility modeling, wired-wireless networks. Lab: wireless LAN measurement, mobile-IP, ad hoc routing.</p>		<p><i>Introduced EE652</i> WIRELESS SENSOR NETWORKS -- Sensor network applications, design and analysis. Deployment; energy-efficiency; wireless communications; data-centric operation; capacity and lifetime; collaborative signal processing; reliability, fault-tolerance and security.</p>		

Robotics

Year	545	546L	547	548
83-84	EE545 INTRODUCTION TO ROBOTICS -- Fundamental concepts; kinematics; actuators; architectures of robotic systems; dynamics, force, and control; sensing by vision; proximity, and touch; robot programming languages; planning and modeling	EE546L BASIC ROBOTIC LABORATORY -- Laboratory exercises using microcomputers and small robots involving software, simulation, positioning, collision avoidance, sensor interfaces.	EE547 SOFTWARE METHODS IN ROBOTICS -- Robotic programming languages; robot architectures and operating systems; design of software interfaces; geometric modeling and simulation; collision avoidance and grasping; planning robotic tasks.	EE548 ANALYTICAL METHODS IN ROBOTICS -- Homogeneous transformations; formal description of robot manipulators; kinematic equations and their solution; differential relationships; dynamic; control; static forces; compliance.
94	Robotics program transferred to Computer Science Department			

Evolution of courses in programming and software

Year	101	355	455/456L	555
67-68		<p><i>Introduced EE455</i> INTRODUCTION TO PROGRAMMING SYSTEM DESIGN -- Organization and design of computer software; assemblers, compilers, interpreters, and operating systems. Experience in constructing and testing of programming systems.</p> <p><i>Introduced EE456L</i> COMPUTER LABORATORY -- Machine language programming. Construction and testing of elementary programming systems.</p>		
70-71		<p><i>Introduced EE355</i> PROGRAMMING LANGUAGES -- Studies in the use of several languages, including an assembly language, a list processing language.</p>		
71-72		<p><i>Introduced EE555ab</i> modified to read PROGRAMMING SYSTEM DESIGN -- <i>a</i>: Survey of concepts in software systems: performance measures, queuing theory, modeling. <i>b</i>: Theory and design of translation systems: formal grammars, parsing, code generation, global optimization, compiler-compilers.</p> <p><i>Introduced EE653</i> SEMINAR IN PROGRAMMING THEORY -- Recent developments in programming theory.</p>		
74-75	<p><i>Introduced EE101</i> INTRODUCTION TO ENGINEERING COMPUTATION -- Elementary computer programming; applications to engineering problems.</p>		<p>EE456L modified to read INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING -- Assembly and machine language programming of computers, such as the IBM 360.</p>	
1976	<p>Programming/software classes transferred to Computer Science Department</p>			

Time line of introduction/major modification of course listings, acquisition of faculty, and departmental restructuring

- **1950 - SoE Bulletin EE Department:** No computer related classes identified

- **53-55 Bulletin**
 - *Introduced* **EE552** DIGITAL COMPUTING DEVICES -- General properties of **digital computers**; **mathematical theory of design**; **gates, flip-flops, magnetic drums, storage tubes.**

- **55-57 Bulletin**
 - **EE552** modified to read -- DIGITAL COMPUTERS -- General properties of digital computers; mathematical theory of design, gates, flip-flops, **memory devices**, design of **logical networks**.
 - *Introduced* **EE553** ANALOG COMPUTERS -- Electrical analog of physical systems; active and passive circuit analogies; **synthesis of transfer functions with operational amplifiers**; **function generation**; **scaling**; **computer utilization.**

- **57-58 Bulletin** (New faculty: Zohrab A. Kaprielian joins department as a Visiting Assistant Professor; soon becomes Department Chair, Dean and eventually Provost)
 - **EE552** modified to read **EE552ab** DIGITAL COMPUTERS -- **Switching algebras** (Boolean algebra). Circuits which perform **arithmetic and control functions digitally**; computer organization, **memory systems**; **introduction to programming. Experience in operating a digital computer.**
 - **EE553** modified to read **EE553ab** ANALOG COMPUTERS -- Computing elements; setting up problems; problem scaling and checking, **input-output devices, function generators**, and **methods of representing nonlinearities.**

- **59-60 Bulletin** (New faculty: Robert McGhee - lecturer in EE with focus on computing)
 - *Introduced* **EE554** INCREMENTAL ELECTRONIC COMPUTERS -- Integration by numerical means to solve differential and algebraic equations; **digital differential analyzers** in industrial control. **Computer available for class use.**

- **59-60 Bulletin** (New faculty: Robert McGhee - lecturer in EE with focus on computing)
 - *Introduced* **EE554** INCREMENTAL ELECTRONIC COMPUTERS -- Integration by numerical means to solve differential and algebraic equations; **digital differential analyzers** in industrial control. **Computer available for class use.**

- **60-61 Bulletin** (No significant changes)

- **61-62 Bulletin**
 - *Introduced* **EE452** DESIGN OF ANALOG AND DIGITAL COMPUTERS -- Design of digital and analog computers from a block diagram viewpoint, including elements of logical design and coding.

- **62-64 Bulletin** not available (New faculty: Robert McGhee Assist. Prof. EE)

- **64-65 Bulletin** (New faculty: George Bekey Assist. Prof. EE)
 - **EE452** modified to read INTRODUCTION TO ANALOG AND DIGITAL COMPUTER DESIGN -- **Analog computer programming; machine language programming of digital computers;** design from a block diagram viewpoint; switching theory; example problems on digital and analog computers.
 - *Introduced* **EE478** PULSE AND DIGITAL CIRCUITS -- Design of wave shaping circuits; transistor nonlinear models; design of linear sweeping circuits, **electronic gates, multistable circuits;** negative resistance circuits.
 - **EE552ab** modified to read LOGICAL DESIGN OF DIGITAL COMPUTERS -- Switching theory; digital computer logical design; **real time computing systems; analog-digital conversion;** digital differential analyzers and other special purpose computers; computer software development.
 - **EE553ab** modified to read **EE553** ANALOG COMPUTATION -- Electronic analog solutions of linear and nonlinear problems; **repetitive computers;** iterative techniques; **analog storage; implicit techniques, gradient methods** and applications, **error analysis** of computer solutions.
 - **EE554** modified to read HYBRID COMPUTATION -- **Hybrid analog-digital computer systems.** Applications to the solution of partial differential equations; **system identification and optimization** problems; **random process studies; adjoint techniques; mathematical programming problems.**
 - *Introduced* **EE652** SEMINAR IN COMPUTER THEORY -- Logical design, **artificial intelligence; patterns recognition; computer control** of industrial processes.

- **65-66-67 Bulletins** not available (New faculty: Melvin A. Breuer Assist. Prof. EE)
- **67-68 Bulletin** (New faculty: Seymour Ginsburg Visiting Assoc. Prof. EE, William K. Pratt Assist. Prof. EE)
 - **EE452** modified again to read INTRODUCTION TO DIGITAL SYSTEM DESIGN -- Switching theory; logical design of digital computers; digital differential analyzers and other special purpose computers.
 - *Introduced* **EE455** INTRODUCTION TO PROGRAMMING SYSTEM DESIGN -- Organization and design of computer software; **assemblers, compilers, interpreters, and operating systems.** Experience in constructing and **testing** of programming systems.
 - *Introduced* **EE456L** COMPUTER LABORATORY -- Machine language programming. Construction and testing of elementary programming systems.
 - *Introduced* **EE479L** PULSE AND DIGITAL CIRCUITS LABORATORY -- Experimental work related to EE478. Advanced switching circuits, pulse and digital systems, **computer aided circuit design.**
 - **EE552ab** modified to read THEORY AND DESIGN OF DIGITAL MACHINES -- Switching theory; digital computer logical design; digital differential analyzers and other special purpose computers; **asynchronous** sequential machines; **Turing machines.**
 - **EE553** modified to read ANALOG AND DIGITAL COMPUTATION -- Analog and digital solution of linear and nonlinear problems; iterative techniques; analog storage; implicit techniques, gradient methods and applications, error analysis of computer solutions.
 - *Introduced* **EE555ab** PROGRAMMING SYSTEM DESIGN -- Organization and design of systems for **sequential, concurrent** and **time-shared** processing both **on line** and **off line.** Design of system components for **assembly, compilation, and interpretation.**
 - Modified **EE652** to be **EE652ab** SEMINAR IN COMPUTER THEORY -- Logical design, artificial intelligence, pattern recognition, **automata theory, simulation and modeling, computer languages.**
- **68-69 Bulletin** (No significant changes)

- **69-70 Bulletin** (New faculty: George E. Mager Assist. Prof. EE, William S. Meisel Assist. Prof. EE, Harry C. Andrews Assist. Prof. EE, Robert F. Tooper Assist. Prof. EE. Research Associates included Edward Angel, Roger Card and David Collins. Many of the faculty are listed as Assist., Assoc., or Prof. of Electrical Engineering and Computer Science. In addition a Computer Science Program was established with a faculty taken primarily from EE and Math and consisting of Edward Blum (Math), Reed, Ginsburg, Jack Munushian (EE and Program Director); Breuer, Mager, Meisel and Michael Merritt (Aerospace Engineering). The Computer Science Program offers MS and PhD degrees from the College.
 - **EE452** modified to read INTRODUCTION TO LOGICAL DESIGN OF DIGITAL COMPUTERS -- Digital logic, **Karnaugh** map minimization, **number systems**, digital arithmetic, state devices, **basic analysis and synthesis**, and introduction of digital subsystems.
 - *Introduced* **EE453** INTRODUCTION TO ANALOG AND DIGITAL COMPUTATION -- Introduction to analog computer programming, amplitude and time scaling, function generation, digital computer solutions of differential equations, linear and nonlinear simultaneous equations, **linear programming**.
 - **EE455** modified to be **EE455L** and made into a 4 unit class.
 - Course descriptions to **EE552ab** significantly modified.
 - *Introduced* **EE556ab** DESIGN AUTOMATION OF DIGITAL COMPUTERS -- **Computational algorithms** and **heuristic procedures** for **simulation**, logic design, implementation, and **diagnosis** of digital computers.
 - *Introduced* **EE557** DIGITAL SYSTEM ARCHITECTURE -- **Computational algorithms**, **look-ahead** and parallel processing, **read-only** and **associative** memories, **memory organization** and system design, **reliability** and **redundancy**, special purpose computers.
 - *Introduced* **EE654** ADVANCED TOPICS IN ANALOG AND DIGITAL COMPUTATION -- Effect of computer structures on methods for the solution of engineering problems, **application oriented languages**, modeling, identification, systems simulation, sensitivity analysis, related topics.
 - Modified **655ab** INTRODUCTION TO AUTOMATA AND FORMAL LANGUAGE THEORY -- **Formal languages**, **context free**; **context sensitive**; **regular**; **ambiguity**; **operations on languages**; **solvability**; automata; **recognition devices**, **transducers**; connections with formal languages; **probabilistic machines**; **decomposition theory**.
 - *Introduced* **EE691ab** SEMINAR IN AUTOMATA AND FORMAL LANGUAGE THEORY -- Recent developments in automata and formal language theory.
 - *Introduced* **EE692ab** SEMINAR IN PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE -- Advanced topics and research progress in pattern recognition and artificial intelligence.

- **69-70 Bulletin continued.** The following courses are listed in the Computer Science Program.
 - 501ab APPLICATIONS OF DIGITAL COMPUTATION
 - 502ab NUMERICAL ANALYSIS (Same as Mathematics 502ab)
 - 503 MATHEMATICAL PROGRAMMING (Same as Mathematics 503)
 - 504 NUMERICAL SOLUTIONS OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (Enroll in Mathematics 504)
 - 505ab APPLIED PROBABILITY AND STATISTICS (Enroll in Mathematics 505ab)
 - 533 COMBINATORIAL ANALYSIS AND ALGEBRA (Same as Mathematics 533)
 - 552ab (Same as EE552ab)
 - 553 (Same as EE553)
 - 554 (Same as EE554)
 - 555ab (Same as EE555ab)
 - 556ab (Same as EE556ab)
 - 557 (Enroll in EE557)
 - 559ab (Enroll in 559ab)
 - 561 (Enroll in EE561)
 - 562 RECURSIVE FUNCTIONS AND COMPUTABILITY (Same as Mathematics 562)
 - 563 LOGIC, MODEL THEORY, AND THEORY OF PROGRAMMING (Same as Mathematics 563)
 - 601 ADVANCED TOPICS IN PROGRAMMING
 - 652ab (Enroll in EE652ab)
 - 654 (Enroll in EE654)
 - 655ab (Enroll in EE655ab)
 - 672ab SPECIAL TOPICS IN COMPUTER SCIENCE
 - 692ab (Enroll in EE692ab)
- **70-71 Bulletin** (New faculty: William J. Chandler Assist. Prof. EE, Philip Gilbert Assist. Prof. EE&CS)
 - *Introduced* EE355 PROGRAMMING LANGUAGES -- Studies in the use of several languages, including an assembly language, a **list processing** language. *Prerequisite:* Knowledge of FORTRAN or equivalent.

- **71-72 Bulletin** (New faculty and miscellaneous notes. Monte Ung receives his PhD from USC; F. Roy Carlson Assist. Prof. EE, Robert S. Kashef Assist. Prof. EE, Albert Zobrist Assist. Prof. EE. EE Department partitioned into two semi-autonomous divisions named EE-Systems and EE-Electrophysics. What is considered in this report to be Computer Engineering is made a program in EE-Systems and only this aspect of history will be described in what follows.)
 - *Introduced* EE201L INTRODUCTION TO DIGITAL CIRCUITS -- Switching algebra; formulation and synthesis of switching functions; realization of logical circuits using relays and solid state devices; clocked sequential circuits, counters, shift registers, adders. (Very similar to EE452)
 - Old **EE552a** replaced by **EE452**, and old **EE552b** becomes **EE552**.
 - **EE453** modified to read INTRODUCTION TO COMPUTATIONAL TECHNIQUES -- Numerical solutions to nonlinear algebraic and transcendental equations; matrix methods; systems of linear equations; numerical integration; digital and analog computer solutions of differential equations; simulation.
 - **EE553** modified to read COMPUTATIONAL SOLUTIONS OF OPTIMIZATION PROBLEMS -- Computer algorithms for system optimization; search techniques, gradient methods, parameter optimization in control systems; optimization with constraints; linear and nonlinear programming; random search techniques.
 - **EE554** modified to read REAL TIME SYSTEMS -- Hardware and software problems associated with interaction of digital computers with continuous processes; application to process control, hybrid computers, and data acquisition.
 - **EE555ab** modified to read PROGRAMMING SYSTEM DESIGN -- *a*: Survey of concepts in software systems: performance measures, queuing theory, modeling. *b*: Theory and design of translation systems: formal grammars, parsing, code generation, global optimization, compiler-compilers.
 - *Introduced* **EE575ab** MAN-MACHINE INTERACTIVE SYSTEMS -- *a*: Computer graphics; hardware for highly interactive systems; clipping, scaling, rotation, hidden line elimination; data structures for graphics; applications of graphics to animation, design, scientific research. *b*: Linguistic approaches to interactive systems; picture languages, syntax-directed recognition and generation of displays; linguistic approach to adaptive behavior in interactive systems.
 - *Introduced* **EE653** SEMINAR IN PROGRAMMING THEORY -- Recent developments in programming theory.
 - *Introduced* **EE576** SWITCHING AND AUTOMATA THEORY -- Structure theory of sequential machines; transition systems and regular expressions; Turing machines; machine decomposition, cellular automata; failure-tolerant system design.
 - CS Program *introduced* **EE656ab** AFL THEORY

- **72-73 Bulletin** (New faculty: Arthur D. Friedman Assoc. Prof. EE, John P. Hayes Assist. Prof. EE)
 - CS Program *introduces* 101L FUNDAMENTALS OF COMPUTER SCIENCE
 - CS Program *introduces* 102L ASSEMBLY LANGUAGE PROGRAMMING
 - CS Program *introduces* 140 COMPUTERS AND SOCIETY
 - CS Program *introduces* 201 PROGRAMMING LANGUAGES
 - CS Program *introduces* 202 DATA STRUCTURES
 - CS Program *introduces* 301 THEORY OF COMPUTATION
 - CS Program *introduces* 302 OPERATING SYSTEMS
 - CS Program *introduces* 311 DIGITAL SYSTEM ORGANIZATION
 - CS Program *introduces* 312 RECURSIVE FUNCTION THEORY
 - CS Program *introduces* 330 FINITE AUTOMATA THEORY
 - CS Program *introduces* 410 TRANSLATION OF PROGRAMMING LANGUAGES
 - CS Program *introduces* 450 INTRODUCTION TO SWITCHING THEORY (Enroll in EE452)
 - CS Program *introduces* 457 INTRODUCTION TO COMPUTER ARCHITECTURE (Enroll in EE457)
 - CS Program *introduces* 460 ARTIFICIAL INTELLIGENCE
 - CS Program *introduces* 470 SIMULATION OF DISCRETE SYSTEMS
 - CS Program *introduces* 480 COMPUTER GRAPHICS

- **73-74 Bulletin** (New faculty: Ellis Horowitz Assist. Prof. EE/CS, Tomas N. Hibbard Assist. Prof. EE/CS, Robert H. Anderson Assoc. Prof. Computer Science*, Robert M. Balzer Assoc. Prof. Computer Science*, Ralph J. London Assoc. Prof. Computer Science*, Donald R. Oestreicher Assist. Prof. Computer Science*, Keith W. Uncapher Prof. Computer Science*; *--home unit is USC/Information Sciences Institute)
 - **EE552** modified to read THEORY AND DESIGN OF DIGITAL MACHINES -- Abstract algebra; properties of switching functions, functional decomposition, multioutput, multilevel network synthesis; analysis, minimization, state assignment, synthesis of sequential machines; general purpose digital computer design.
 - CS Program *introduced* 212L (Enroll in EE201L)
 - CS Program *introduced* 577 DESIGN AND CONSTRUCTION OF LARGE SOFTWARE SYSTEMS
 - CS Program *introduced* 601 ADVANCED TOPICS IN PROGRAMMING
 - CS Program *introduced* 653 SEMINAR IN PROGRAMMING THEORY
 - CS Program *introduced* 691ab SEMINAR IN AUTOMATA AND FORMAL LANGUAGE THEORY

- **74-75 Bulletin** (New faculty: Armin Cremers Assist. Prof. EE/CS, Kwang H. Kim Assist. Prof. EE/CS, Erica M. Rounds Assist. Prof. EE/CS)
 - *Introduced* **EE101** INTRODUCTION TO ENGINEERING COMPUTATION -- Elementary computer programming; applications to engineering problems.
 - **EE456** modified to read **EE456L** INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING -- Assembly and machine language programming of computers, such as the IBM 360.
 - **EE556ab** *modified* to **EE580** and **EE556**.
 - **EE556** DIAGNOSIS AND RELIABLE DESIGN OF DIGITAL SYSTEMS -- Test generation for combinational and sequential circuits, checking experiments, gate level simulation, easily diagnosable and fault tolerant system level design procedures, specific system studies.
 - **EE580** DESIGN AUTOMATION OF DIGITAL SYSTEMS -- High-level computer design languages and their applications in logic design and verification of digital systems; physical packaging, partitioning, assignment, placement, interconnection problems.
 - Modified **EE557** to read **EE557ab** DIGITAL SYSTEM ARCHITECTURE -- *a*: Basic machine organization; operating systems; addressing techniques; memory organization; instruction sets; microprogramming, parallelism; channels and controllers. *b*: Advanced concepts in parallel processing. Survey of various classes of processors such as minicomputers, classical stack, associative, array, and high level language processors.

- **75-76 Bulletin** (New faculty: Ramakant Nevatia Assist. Prof. EE/CS, David Russell Assist. Prof. EE/CS)
 - CS Program *introduced* 565 COMPILER DESIGN
 - CS Program *introduced* 578 MICROPROGRAMMING
 - CS Program *introduced* 579 GRAPH THEORY AND APPLICATIONS
 - CS Program *introduced* 665 PROGRAMMING SYSTEM DESIGN

- **76-77 Bulletin** (New faculty: John V. Guttag Assist. Prof. Computer Science, Per Brinch-Hansen Professor Computer Science) Computer Science Department formed with Brinch-Hansen as its chair. Some faculty from EE change their home department to be CS.
 - CS Home: Brinch-Hansen, Carlson, Ginsberg, Guttag, Horowitz, Rounds, Russell
 - EE Home: Andrews, Bekey, Breuer, Friedman, Hayes, Kim, Nevatia, Reed
 - Other: Blum (Math), Balzer(ISI), London(ISI), Lynch(Math), Ostreicher(ISI), Uncapher(ISI)

The following classes were transferred from being EE_{xxx} to CS_{xxx}

 - 455ab INTRODUCTION TO PROGRAMMING SYSTEMS DESIGN
 - 456L INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING
 - 555 OPERATING SYSTEMS
 - 561 SURVEY OF ARTIFICIAL INTELLIGENCE
 - 575ab MAN-MACHINE INTERACTIVE SYSTEMS
 - 652ab SEMINAR IN COMPUTER THEORY
 - 653 SEMINAR IN PROGRAMMING THEORY
 - 654 ADVANCED TOPICS IN ANALOG AND DIGITAL COMPUTATION
 - 655ab AUTOMATA AND FORMAL LANGUAGE THEORY
 - 691ab SEMINAR IN AUTOMATA AND FORMAL LANGUAGE THEORY
 - 692ab SEMINAR IN PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE

- **77-78 Bulletin** not available

- **78-79 Bulletin**
 - *Introduced* **EE550** COMMUNICATION NETWORK DESIGN -- Overview of computer communication networks: technologies and techniques. Design issues, capacity assignment, flow assignment, topological design, buffer allocation, routing, and flow control.

- **79-80 Bulletin** (New faculty: John Andrew Silvester Assist. Prof. EE; no significant changes)
- **80-81 Bulletin** (New faculty: Israel Koren Assist. Prof. EE, Alexander Thomasian Assist. Prof. EE, Toshima Minora Assist. Prof. EE)
 - *Introduced EE454L* INTRODUCTION TO SYSTEMS DESIGN USING MICROPROCESSORS -- Microcomputer processing and programming; microprocessor organization and technology; applications of microprocessors; student group design project in microprocessor laboratory including system design, implementation, and debugging.
 - *Introduced EE549* ANALYTIC METHODS IN COMPUTER SYSTEM MODELING -- Queueing theory and its applications to performance modeling of computer systems; models of time sharing, scheduling, memory management, and resource sharing.
 - *Introduced EE560L* ADVANCED MICROCOMPUTER-BASED DESIGN -- Advanced design projects using the microcomputer laboratory: multiprocessor design, microprogramming systems, fault-tolerant computers, graphics systems, voice recognition and synthesis, process control.
- **81-82 Bulletin** (New faculty: Alice Parker Assist. Prof. EE; no significant changes)
- **82-83 Bulletin** (New faculty: Dan I. Moldovan Assist. Prof. EE, Barry Soroka Assist. Prof. EE)
 - *Introduced EE577* VERY LARGE SCALE INTEGRATION (VLSI) -- Circuit characteristics of metal oxide semiconductor devices; logic families; limits of technology. System architectures, timing, highly concurrent systems. Computer-assisted design. Applications. Chip design project.
 - Modified **EE549** to read QUEUEING THEORY FOR PERFORMANCE MODELING OF COMPUTER SYSTEMS -- Review of Markov chains and simple queueing theory; advanced queueing theory; approximations, open and closed networks of queues; computational techniques; priority queueing; scheduling.
 - Modified **EE550** to read DESIGN AND ANALYSIS OF COMPUTER COMMUNICATION NETWORKS - - ISO/OSI reference model; performance models of communication networks; network design; protocols; virtual circuits/datagram; routing, congestion control, flow control; local networks; satellite protocols; broadcasting networks.

- **83-84 Bulletin** (New faculty: Jean-Luc Gaudiot Assist. Prof. EE, Cauligi S. Raghavendra Assist. Prof. EE)
 - **EE201L** *modified* to be **EE101** followed by **EE102L**
 - **EE101** INTRODUCTION TO DIGITAL LOGIC -- Boolean algebra; number systems; binary arithmetic; codes; gates; Boolean expressions; Boolean switching function synthesis; iterative arrays; sequential machines; state machines; flip-flops; sequential circuits; simple processors.
 - **EE102L** INTRODUCTION TO DIGITAL CIRCUITS -- Advanced logic design; case studies; finite state machines controllers-hardwired and microprogrammed; MSI/LSI devices; timing, loading, clocking, optimization; design tradeoffs; lab experiments.
 - *Introduced* **EE357** BASIC ORGANIZATION OF COMPUTER SYSTEMS -- Organization and operation of the processor, memory and I/O of a minicomputer at the machine language level; assembly language programming; data representation and computer arithmetic.
 - *Introduced* **EE449** COMPUTER SYSTEM MODELING TECHNIQUES -- Discrete mathematics for modeling computer systems; set theory; relations; graphs; networks; combinatorics; probability and applications to reliability and performance modeling; simple queueing theory.
 - Modified **EE457L** to read COMPUTER SYSTEMS ORGANIZATION -- Register transfer level machine organization; CPU data paths and control; microprogramming; timing, simple arithmetic units; basic I/O organization; design using register transfer languages in Lab.
 - *Introduced* **EE545** INTRODUCTION TO ROBOTICS -- Fundamental concepts; kinematics; actuators; architectures of robotic systems; dynamics, force, and control; sensing by vision; proximity, and touch; robot programming languages; planning and modeling
 - *Introduced* **EE546L** BASIC ROBOTIC LABORATORY -- Laboratory exercises using microcomputers and small robots involving software, simulation, positioning, collision avoidance, sensor interfaces.
 - *Introduced* **EE547** SOFTWARE METHODS IN ROBOTICS -- Robotic programming languages; robot architectures and operating systems; design of software interfaces; geometric modeling and simulation; collision avoidance and grasping; planning robotic tasks.
 - *Introduced* **EE548** ANALYTICAL METHODS IN ROBOTICS -- Homogeneous transformations; formal description of robot manipulators; kinematic equations and their solution; differential relationships; dynamic control; static forces; compliance.

- **83-84 Bulletin continued**
 - Modified **EE552** to read LOGIC DESIGN AND SWITCHING THEORY II -- State minimization of incompletely specified sequential circuits; asynchronous sequential circuits; races; state assignments; combinational and sequential hazards in logic circuits.
 - Modified **EE556** to read **EE658** DIAGNOSIS AND DESIGN OF RELIABLE DIGITAL SYSTEMS -- Fault models; test generation; fault simulation; self-checking and self-testing circuits; design for testability; fault tolerant design techniques; case studies.
 - Modified **EE580** to read **EE680** COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS -- Synthesis; partitioning; placement; routing of digital circuits; integrated circuit design methods; simulation at the switch, gate, register transfer and system levels.
 - *Introduced* **EE649** PERFORMANCE EVALUATION OF COMPUTING SYSTEMS -- Performance modeling; measurement and evaluation techniques; CPU scheduling disciplines; queueing network models; aggregation and decomposition; approximate queueing network models; memory hierarchies; memory interface; reliability models.
 - *Introduced* **EE650** ADVANCED TOPICS IN COMPUTER NETWORKS -- Protocol modeling; flow and congestion control, dynamic routing, distributed implementation; broadcast communication media and multiple access protocols; local networks, satellite networks, terrestrial radio networks.
 - *Introduced* **EE657** PARALLEL PROCESSING -- Array processors, multiprocessors, pipeline processors; data flow computers; VLSI architectures; parallel numerical and non-numerical algorithms; mapping algorithms onto computer structures.

- **84-85 Bulletin** (New faculty: V. K. Prasanna-Kumar Assist. Prof. EE, M. Dubois Assist. Prof. EE, Sukhan Lee Assist. Prof. EE; no significant changes)
 - Modified **EE454L** to read INTRODUCTION TO SYSTEMS DESIGN USING MICROPROCESSORS -- Operation and timing of 8-bit microprocessor; design of microprocessor based systems; 16-bit microprocessors; bit sliced microprocessors.

- **85-86 Bulletin** (New faculty: Sarma Sastry Assist. Prof EE, Kai Hwang Prof. EE/CS)
 - *Introduced EE656* FAULT TOLERANT COMPUTING SYSTEMS -- Fault classification, measures of reliability, modeling and evaluation. Detection and recovery schemes; case studies of recent designs. Reliability analysis of networks and distributed systems.
 - *Introduced EE659* INTERCONNECTION NETWORKS -- Theory, design and analysis of interconnection networks for multiprocessor systems. Study of regular, Omega, binary n-cube, Delta, Gamma networks; control algorithms; mapping algorithms to architectures.

- **86-87 Bulletin** (New faculty: James Yee Assist. Prof. EE; no significant changes)

- **87-88 Bulletin** (New faculty: Gerard G. Medioni Assist. Prof EE/CS)
 - Modified **EE550** to read DESIGN AND ANALYSIS OF COMPUTER COMMUNICATION NETWORKS -- Applications of stochastic modeling and optimization techniques to communication network design and analysis. Data link control; performance models; multi-access channels; routing and control flow.
 - *Introduced EE653* DATA-FLOW COMPUTERS AND FUNCTIONAL PROGRAMMING -- Programmability of general purpose multiprocessors systems, functional programming, data-flow multicomputers, existing prototypes, fault-tolerance.

- **88-89 Bulletin** (New faculty: William P-C. Ho Assist. Prof. EE; no significant changes)

- **89-90 Bulletin** (New faculty: Alvin Despain Prof. EE/CS; no significant changes)

- **90-91 Bulletin** (No significant changes)

- **91-92 Catalogue**
 - *Introduced EE465* PROBABILISTIC METHODS IN COMPUTER SYSTEMS MODELING -- Review of probability; random variables; stochastic processes; Markov chains; and simple queueing theory. Applications to program and algorithm analysis; computer system performance and reliability modeling.

- **92-95 Catalogue** (New faculty: Massoud Pedram Assist. Prof. EE, Sandeep K. Gupta Assist. Prof. EE, Kenneth Goldberg Assist. Prof. EE/CS, Timothy Pinkston Assist. Prof. EE (1993), Peter Beerel Assist. Prof. EE (1994)).
 - *Introduced* **EE459L** SENIOR DESIGN PROJECT -- Design, implementation and test of a computer hardware project; architecture, I/O interfaces, application specific hardware; presentation and demonstration.
 - Modified EE577 to EE577ab VLSI SYSTEM DESIGN.
 - EE577a -- Integrated circuit fabrication; circuit simulation; basic device physics; simple device layout; structured chip design; timing; project chip; MOS logic; system design silicon compilers.
 - EE577b -- VLSI design project; preparation of chips for fabrication; testing fabricated chips; design examples; design of specific units (e.g. buses); design techniques; system integration.
 - **EE649** modified to read APPLIED PERFORMANCE EVALUATION OF COMPUTER SYSTEMS -- Performance evaluation techniques for hardware/software system design, capacity planning, system tuning and equipment procurement. Techniques include workload characterization and analytical models.
 - *Introduced* **EE677** VLSI ARCHITECTURES AND ALGORITHMS -- VLSI models; measures of area; volume and time; mapping algorithms; systolic arrays; area time tradeoffs; application to signal and image processing problems.
 - Modified **EE680** to **EE680** and **EE681**.
 - **EE680** COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS I -- Synthesis, partitioning; placement; routing of digital circuits; integrated circuit design methods; simulation at the switch, gate, register transfer and system level.
 - **EE681** COMPUTER AIDED DESIGN OF DIGITAL SYSTEMS II -- Theory and techniques for design and analysis of digital logic; specifications and formal models; hardware-descriptive models; formal verification; high level synthesis; logic synthesis.

- **95-96 Bulletin** (New faculty: Ahmed Helmy Assist. Prof. EE/CS)
 - *Introduced* **EE555** BROADBAND NETWORK ARCHITECTURE -- ATM and BISDN, switch designs, high speed local, campus and metropolitan area networks; lightwave and photonic networks; network management techniques, applications and gigabit network applications.
 - *Introduced* **EE582** TECHNICAL SEMINAR ON VLSI DESIGN -- VLSI design topics; packaging; design; multiple-chip modules; field-programmable gate arrays; thermal analysis; advanced technologies; fabrication; high speed circuitry; commercial CAD/CAE packages.
 - Modified **EE649** to read APPLIED PERFORMANCE EVALUATION OF COMPUTER SYSTEMS -- Performance evaluation techniques for hardware/software system design, capacity planning, system tuning and equipment procurement. Techniques include workload characterization and analytic models.
 - Modified **EE653** to read MULTITHREADED ARCHITECTURES, DATA-FLOW COMPUTING AND FUNCTIONAL PROGRAMMING -- Programmability of general purpose multiprocessor systems, functional programming, data-flow and multithreaded computers, existing prototypes, fault-tolerant issues.
 - *Introduced* **EE661** PARALLEL KNOWLEDGE PROCESSING -- Parallel approaches to knowledge representation and reasoning. Topics range from the analysis of parallelism to the design of special purpose computer systems.

- **96-97 Bulletin**
 - *Introduced* **EE477L** MOS VLSI CIRCUIT DESIGN -- Analysis and design of digital MOS VLSI circuits including area, delay and power minimization. Laboratory assignments including design, layout, extraction, simulation and automatic synthesis.
 - *Introduced* **EE450** INTRODUCTION TO COMPUTER NETWORKS -- Network architectures; layered protocols, network service interface; local networks; long-haul networks; internal protocols; link protocols; addressing; routing; flow control; higher level protocols.

- **97-98 Catalogue (No significant changes)**
- **98-99 Catalogue**
- **99-00 Catalogue** (New faculty: Won Namgoong Assist. Prof. EE: No significant changes)
- **00-01 Catalogue**
 - Modified **EE560L** to **EE560** DIGITAL SYSTEM DESIGN-TOOLS AND TECHNIQUES -- ASIC design, FPGAs, VHDL, Verilog, test benches, simulation, synthesis, timing analysis, post-synthesis simulation, FIFOs, handshaking, memory interfaces, PCI bus protocols, CAD tools, design lab exercises.
- **01-02 Catalogue** (missing)
- **02-03 Catalogue** (New faculty: Bhaskar Krishnamachari Assist. Prof. EE: No significant changes)
- **03-04 Catalogue** (New faculty: Konstantinos Psounis Assist. Prof. EE)
 - *Introduced* **EE532** WIRELESS INTERNET AND PERVASIVE COMPUTING -- Wireless Internet access technologies, 3G cellular systems, WAP and PKI protocols, mobile computing devices, network security for mobile E-commerce, software and middleware for pervasive, cluster, grid, and Internet computing.
- **04-05 Catalogue**
 - *Introduced* **EE652** WIRELESS SENSOR NETWORKS -- Sensor network applications, design and analysis. Deployment; energy-efficiency; wireless communications; data-centric operation; capacity and lifetime; collaborative signal processing; reliability, fault-tolerance and security.
 - *Introduced* **EE579** WIRELESS AND MOBILE NETWORKS DESIGN AND LABORATORY -- Mobil ad hoc networks: ad hoc and geographic routing, resource discovery, medium access control, IP-mobility, mobility modeling, wired-wireless networks. Lab: wireless LAN measurement, mobile-IP, ad hoc routing.

- **05-06 Catalogue**
 - **EE102L** modified to read **EE201L** INTRODUCTION TO DIGITAL CIRCUITS -- Digital system design and implementation using discrete ICs and FPGAs; synchronous design of datapath and control units; state machine implementation methods; timing analysis; lab experiments, logic analyzers; schematic-entry and simulation; semester-end project.
 - **EE459** modified to read **EE459L** EMBEDDED SYSTEM DESIGN LABORATORY -- Specification, design, implementation, testing and documentation of a digital system project using embedded processors, programmable logic; analog I/O interfaces and application specific hardware.

- **06-07 Catalogue**
 - *Introduced* **EE106L** INTRODUCTION TO COMPUTER ENGINEERING/COMPUTER SCIENCE -- Examination of key disciplines of computing systems; architectures, operating systems, digital logic, VLSI, networks, AI, robotics, graphics, and algorithms. Includes hardware/software laboratory tours and exercises.

- **07-08 Catalogue** (New faculty: Murali Annavaram Assist. Prof. EE)
 - **EE552** modified to read ASYNCHRONOUS VLSI DESIGN -- Asynchronous channels and architectures; implementation design styles; controller synthesis; hazards, and races; Petri-nets; performance analysis, and optimization; globally asynchronous locally synchronous design.
 - *Introduced* **EE581** MATHEMATICAL FOUNDATIONS FOR COMPUTER-AIDED DESIGN OF VLSI CIRCUITS -- Mathematical techniques employed in computer-aided-design systems, including: graph theory, algorithmic and heuristic techniques for combinatorial problems, data structures and modeling.

- **08-09 Catalogue** (New faculty: Rahul Jain Assist. Prof. EE)