

---

# Electrical and Computer Engineering

**OFFICE:** Engineering 426  
**TELEPHONE:** 619-594-5718  
**E-MAIL:** [ee@engineering.sdsu.edu](mailto:ee@engineering.sdsu.edu)  
**http://electrical.sdsu.edu**

## Faculty

R. Lal Tummala, Ph.D., Professor of Electrical and Computer Engineering, Chair of Department  
Madhu S. Gupta, Ph.D., Professor of Electrical and Computer Engineering, Radio Frequency Communications Systems Industry Chair  
fredric j. harris, M.S.E.E., P.E., Professor of Electrical and Computer Engineering  
Jay H. Harris, Ph.D., Professor of Electrical and Computer Engineering  
Paul T. Kolen, Ph.D., Professor of Electrical and Computer Engineering  
Gordon K.F. Lee, Ph.D., Professor of Electrical and Computer Engineering (Graduate Adviser)  
Long C. Lee, Ph.D., Professor of Electrical and Computer Engineering  
Andrew Y.J. Szeto, Ph.D., P.E., Professor of Electrical and Computer Engineering  
Ramon Betancourt, Ph.D., Associate Professor of Electrical and Computer Engineering  
Sunil Kumar, Ph.D., Associate Professor of Electrical and Computer Engineering  
Yusuf Ozturk, Ph.D., Associate Professor of Electrical and Computer Engineering  
Ashkan Ashrafi, Ph.D., Assistant Professor of Electrical and Computer Engineering  
Premanand Chandramani, Ph.D., Assistant Professor of Electrical and Computer Engineering  
Santosh V. Nagaraj, Ph.D., Assistant Professor of Electrical and Computer Engineering  
Mahasweta Sarkar, Ph.D., Assistant Professor of Electrical and Computer Engineering  
Sridhar Seshagiri, Ph.D., Assistant Professor of Electrical and Computer Engineering  
Satish Kumar Sharma, Ph.D., Assistant Professor of Electrical and Computer Engineering

## Adjunct Faculty

Khurram Waheed, Ph.D., Electrical and Computer Engineering

## Courses Acceptable on Master's Degree Program in Electrical and Computer Engineering (COMPE) (E E)

*Refer to Courses and Curricula and Regulations of the Division of Graduate Affairs sections of this bulletin for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.*

### UPPER DIVISION COURSES

**NOTE: Prerequisites will be enforced in all 500-level courses. A copy of an official transcript will be accepted as proof. For corequisites, an enrollment confirmation form will be accepted.**

**Any course at the 300 level or below must be passed with a grade of C- or better in order to be used as a prerequisite for any subsequent course.**

#### COMPE 560. Computer and Data Networks (3)

Two lectures and three hours of laboratory.  
Prerequisites: Computer Engineering 271 and Electrical Engineering 410.

Wide area and local area networks. Multi-layered protocol models, telephone systems, modems, and network applications.

#### COMPE 561. Windows Database and Web Programming (3)

Prerequisites: Computer Engineering 260.  
Programming applications involving file systems, relational databases, Structured Query Language (SQL), ADO.NET, client-server architecture, multithreading sockets, web servers, web browsers, web services, ASP.NET, Hypertext Markup Language (HTML), and Extensible Markup Language (XML).

#### COMPE 565. Multimedia Communication Systems (3)

Prerequisites: Credit or concurrent registration in Computer Engineering 560.

Design and implementation of multimedia communication systems. Image compression, JPEG, VQ, cell-B standards. Video and audio compression standards, MPEG, MPEG-2, H.26X, G.72X. Data storage systems and multimedia requirements. Networking requirements and networks as multimedia carriers. Transport and network protocols for carrying multimedia over data networks. Multimedia system design, scheduling, congestion control, traffic shaping, buffer management.

#### COMPE 571. Real-Time Operating Systems (3)

Prerequisites: Computer Engineering 260 and 475.  
Real-time kernel, basic kernel services, threading and synchronization, preemptive multithreading, mutexes, spin locks, critical sections, priority scheduling, interrupts, RTOS implementation, memory management, task management, intertask communications.

#### COMPE 572. VLSI Circuit Design (3)

Prerequisites: Computer Engineering 271 and Electrical Engineering 330.

Design of digital integrated circuits based on CMOS technology; characterization of field effect transistors, transistor level design and simulation of logic gates and subsystems; chip layout, design rules, introduction to processing; ALU architecture.

#### COMPE 596. Advanced Computer Engineering Topics (1-3)

Prerequisites: Consent of instructor.

Modern developments in computer engineering. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit of nine units for any combination of Computer Engineering 496 and 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

### Courses Acceptable on Master's Degree Program in Electrical and Computer Engineering (COMPE) (E E)

Refer to Courses and Curricula and Regulations of the Division of Graduate Affairs sections of this bulletin for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

#### UPPER DIVISION COURSES

**NOTE: Prerequisites will be enforced in all 500-level courses. A copy of an official transcript will be accepted as proof. For corequisites, an enrollment confirmation form will be accepted.**

**Any course at the 300 level or below must be passed with a grade of C- or better in order to be used as a prerequisite for any subsequent course.**

#### E E 502. Electronic Devices for Rehabilitation (3)

Two lectures and three hours of laboratory.

Prerequisites: Electrical Engineering 303 or 330.

Recent developments in electronic assistive devices and micro-computers for persons with various disabilities; assessment of disabled persons for suitable technological assistive devices.

#### E E 503. Biomedical Instrumentation (3)

Prerequisites: Engineering 280; Electrical Engineering 410 and 430 (or for Mechanical Engineering majors, Electrical Engineering 303 and Mechanical Engineering 312).

Instrumentation systems to monitor, image, control, and record physiological functions.

#### E E 522. Digital Control Systems (3)

Prerequisites: Electrical Engineering 420.

Digital controls systems; design algorithms including analog-invariance methods, direct digital techniques, and non-parametric approaches such as fuzzy control, neural networks, and evolutionary systems; implementation considerations. (Formerly numbered Electrical Engineering 622.)

#### E E 530. Analog Integrated Circuit Design (3)

Prerequisite: Electrical Engineering 430 with minimum grade of C-.

Advanced treatment of transistor pairs, device mismatches, differential amplifiers, current mirrors, active loads, level shifting, and output stages. Parasitic and distributed device parameters. Economics of IC fabrication and impact on design.

#### E E 534. Solid-State Devices (3)

Prerequisites: Electrical Engineering 434.

Conduction theory of solids. Characteristics of tunnel, backward, breakdown, multilayer and varactor diodes; silicon controlled rectifiers and switches, unijunction transistors, hot electron devices. Lasers and laser applications.

#### E E 539. Instrumentation Circuits I (3)

Prerequisites: Electrical Engineering 430.

Design and analysis of hybrid analog/digital electronic sub-systems incorporated into modern instrument design. Emphasis on operational amplifier based circuit design and analog-to-digital and digital-to-analog conversion processes.

#### E E 540. Microwave Devices and Systems (3)

Prerequisites: Electrical Engineering 450. Recommended: Engineering 510.

Applications of Maxwell's equations to wave propagation. Microwave network parameters; guided wave transmission and reflection. Design of filters, couplers, power dividers and amplifiers. Applications in radar and telecommunications systems.

#### E E 540L. Microwave Design and Measurements Laboratory (1)

Three hours of laboratory.

Prerequisites: Credit or concurrent registration in Electrical Engineering 430L and 540.

Designs, computer simulations, fabrications, and testings of microwave matching networks, couplers, filters, and amplifiers.

#### E E 541. Electro-Optics (3)

Prerequisites: Electrical Engineering 434.

Optical/electronic devices and systems; wave beams; light-matter quantum interactions; incoherent and laser light sources; modulators and detectors. Applications in data transmission, measurement, and materials processing.

#### E E 546. Optical Fiber Communications Systems (3)

Prerequisites: Electrical Engineering 434.

Optical fiber attenuation and dispersion, light-emitting diodes and laser diodes, PIN diodes and avalanche photodiodes, receiver designs, optical power budgets and rise time budgets, applications in digital and analog communication systems.

#### E E 553. Stochastic Signals and Systems (3)

Prerequisites: Electrical Engineering 410.

Random signals, correlation functions, power spectral densities, the Gaussian process, narrow band processes. Applications to communication systems.

#### E E 556. Digital Signal Processing (3)

Prerequisites: Electrical Engineering 410 or Physics 516.

Digital signal processing. Discrete-time signals, transform techniques, and digital filters. Design of FIR and IIR filters, FFTs, and finite length effects on digital systems.

#### E E 558. Digital Communications (3)

Prerequisites: Electrical Engineering 458.

Design of baseband digital communication systems; noise characterization, sampling, quantization, matched filter receivers, bit-error performance, inter-symbol interference, link budget analysis.

#### E E 558L. Communications and Digital Signal Processing Laboratory (1)

Prerequisites: Credit or concurrent registration in Electrical Engineering 556 or 558.

Experiments in modulation techniques, effects of noise on system performance, digital filters, and signal processing.

#### E E 580. Power System Analysis (3)

Prerequisites: Engineering 280, Electrical Engineering 310 and 380.

Modern power system elements; calculation of load flow, fault currents, and system stability.

#### E E 581. Power System Dynamics (3)

Prerequisites: Electrical Engineering 580.

Three-phase faults, symmetrical components, unsymmetrical faults, protective relay operating principles, economic dispatch of thermal power generation units, power system controls, voltage and power stability.

#### E E 596. Advanced Electrical Engineering Topics (1-3)

Prerequisites: Consent of instructor.

Modern developments in electrical engineering. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit of nine units for any combination of Electrical Engineering 496 and 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

#### GRADUATE COURSES

**NOTE: All listed prerequisite courses or their equivalent for computer engineering and electrical engineering courses must be satisfied with a grade of C- or better.**

#### E E 600. Seminar (1-3)

Prerequisites: Consent of instructor.

An intensive study in advance electrical engineering. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

#### E E 620. Linear System Theory and Design (3)

Prerequisites: Electrical Engineering 420.

State models and solutions of the state equations, stability, controllability and observability, realizability and minimal realizations, linear state and output feedback control, introduction to linear optimal control.

#### E E 625. Linear Optimal Control (3)

Prerequisite: Electrical Engineering 620.

Optimal control with emphasis on quadratic methods; regulation and tracking using state-feedback; deterministic and statistical estimator design; frequency shaping and model reduction; singular perturbation techniques and suboptimal control; applications to flight control, robotics and control of power systems.

**E E 631. RF Electronic Circuits (3)**

Prerequisites: Electrical Engineering 410, 430, and 553.

Distinguishing characteristics of RF circuits; analysis of noise and nonlinearity in circuits; frequency-selective and impedance-matching networks. RF amplifiers, oscillators and frequency conversion circuits. Phase-locked loops and their applications.

**E E 634. RF Circuit Design (3)**

Prerequisites: Electrical Engineering 540.

RF component and circuit design in frequency domain and scattering parameter terms. Linear amplifiers, stability considerations, unilateralization, matching techniques, low-noise amplifiers, wideband designs, power amplifiers, linearity considerations, oscillators, and mixers.

**E E 641. RF Wireless Systems (3)**

Prerequisites: Electrical Engineering 450, 553, 558.

Characteristics and performance measures of RF subsystem in wireless communication systems: wireless channel, antenna, modulators and demodulators, low-noise and power amplifiers, oscillators, ADC and DAC; receiver architectures, system-level design of RF front-end.

**E E 642. Optical Communications (3)**

Prerequisites: Electrical Engineering 541 or 546.

Advanced topics of interest in electro-optical communications, including lasers, background light sources, modulators, receivers, optical fiber and atmospheric channels, and adaptive techniques.

**E E 645. Antennas and Propagation (3)**

Prerequisites: Electrical Engineering 540.

Impedance characteristics and radiation patterns of thin linear antenna elements; field intensity calculations. Tropospheric and ionospheric propagation; propagation anomalies.

**E E 650. Modern Communication Theory (3)**

Prerequisites: Electrical Engineering 553 and 558.

Wireless digital communication; bandpass modulation and demodulation, multiple access techniques, broadband signaling techniques, spread spectrum techniques; applications include CDMA and OFDM.

**E E 652. Principles and Applications of Information Theory (3)**

Prerequisites: Electrical Engineering 553 and 558

Information measure of data sources; Shannon's theorem and capacity of communication links; rate-distortion theory and performance of source codes.

**E E 653. Coding Theory (3)**

Prerequisites: Electrical Engineering 558.

Error control for digital information; arithmetic of Galois fields; block, cyclic, convolutional and turbo encoding and decoding; applications in digital communication and computer systems.

**E E 654. Adaptive Algorithms (3)**

Prerequisites: Electrical Engineering 556.

Adaptive DSP algorithms. Time varying, data dependent filters, adaptive predictors, cancelers, equalizers. LMS and RLS algorithms, tapped delay line, lattice, and decision feedback structures. Adaptive beam forming and beam steering.

**E E 655. Modem Design (3)**

Prerequisites: Electrical Engineering 556 and 558.

System level and DSP design of modems for wireless and wireline communications. Study modems for QAM, OFDM, CDMA, and T-1 modulation.

**E E 656. Multirate Signal Processing (3)**

Prerequisites: Electrical Engineering 556.

DSP techniques for sample rate changes in digital filters. Decimation and interpolation, aliasing as a processing option in resampling filters. Applications in communication and entertainment media systems.

**E E 657. Digital Image Processing (3)**

Prerequisites: Electrical Engineering 556.

Theory of two-dimensional signals and systems, image transforms, image enhancement, restoration and compression, image analysis and computer vision.

**E E 658. Advanced Applications of Digital Signal Processing (3)**

Prerequisites: Electrical Engineering 556 or 657.

Concepts of spectral analysis. Applications of DSP to speech encoding. Image coding, fast algorithms applied to speech, image, radar, sonar and geophysical signal processing.

**E E 660. High Speed Networks: Design Principles and Recent Advances (3)**

Prerequisites: Computer Engineering 560.

Provides students with knowledge of recent developments in area of computer networks. Current research in high speed computer networks.

**E E 662. Wireless Sensor Networks (3)**

Prerequisite: Computer Engineering 560.

Sensor platforms, wireless channel characteristics, time synchronization, medium access control, topology control, routing protocols, localization, coverage and placement, detection and tracking, query processing.

**E E 665. Multimedia Wireless Networks (3)**

Prerequisites: Computer Engineering 560 and 565.

Multimedia source characteristics, compressed bitstreams, error resiliency, quality of service, cellular video telephony, multimedia QoS-aware WLAN, peer to peer networks, and multimedia broadcast multicast services.

**E E 672. VLSI System Design (3)**

Prerequisites: Computer Engineering 572.

Design of microprocessor data paths and controllers, memory management, pipelines, multipliers, Risc and multiprocessor systems and applications.

**E E 675. Hardware and Software Co-Design (3)**

Prerequisites: Computer Engineering 475.

Hardware/software co-design and co-verification for a 32-bit microprocessor core based embedded System-on-Chip (SoC) that includes memory, peripherals, direct-memory access, and bus design.

**E E 678. Advanced Computer Design (3)**

Prerequisites: Computer Engineering 475.

Design principles for high performance computers. State-of-the-art in parallel computer systems, including pipelined computers, array processors and multiprocessor systems.

**E E 679. Real-Time Software Engineering (3)**

Prerequisites: Electrical Engineering 675.

Principles of real-time programming and software engineering for microprocessor systems. Concurrent programming and multitasking. Structured programming. Software validation. Team programming projects.

**E E 685. Micro-Electro-Mechanical Systems (MEMS) Design and Applications (3)**

**(Same course as Mechanical Engineering 685)**

Prerequisite: Mechanical Engineering 585.

Design and manufacturing technology for micro- and nano-scale devices. Topics include solid state transducers, microscale physics, biomedical microelectronics, microfluidics, biosensors, and hybrid integration of microfabrication technology. Emphasis on biomedical applications.

**E E 705. Seminar in Communications Systems (1-3)**

Prerequisites: Consent of instructor.

An intensive study in communication theory and systems. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

**E E 720. Advanced Topics in Control/Power Systems (1-3)**

Prerequisites: Graduate level coursework in the area and consent of instructor.

Selected topics in automatic control, robotics, and power system. May be repeated with new content and consent of graduate adviser. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

## Electrical and Computer Engineering

---

### **E E 730. Advanced Topics in Electronics (1-3)**

Prerequisites: Graduate level coursework in the area and consent of instructor.

Selected topics in microelectronics, electronic instrumentation, and integrated circuit design. May be repeated with new content and consent of graduate adviser. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

### **E E 740. Advanced Topics in Physical Electronics (1-3)**

Prerequisites: Graduate level coursework in the area and consent of instructor.

Selected topics in electromagnetic fields and waves, optoelectronics, and semiconductor devices. May be repeated with new content and consent of graduate adviser. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

### **E E 750. Advanced Topics in Communications (1-3)**

Prerequisites: Graduate level coursework in the area and consent of instructor.

Selected topics in communication theory, wireless and wireline systems, and telecommunications engineering. May be repeated with new content and consent of graduate adviser. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

### **E E 770. Advanced Topics in Computer Engineering (1-3)**

Prerequisites: Graduate level coursework in the area and consent of instructor.

Selected topics in computer and digital system engineering. May be repeated with new content and consent of graduate adviser. See *Class Schedule* for specific content. Maximum credit six units applicable to a master's degree.

### **E E 795. Internship/Practicum (1) Cr/NC**

Prerequisites: Eighteen units of graduate level coursework in electrical engineering and consent of adviser.

Supervised internship or practicum experience with approval of graduate adviser. Not applicable to an advanced degree. Maximum credit three units.

### **E E 797. Research (1-6) Cr/NC/RP**

Prerequisites: Consent of department chair. Open only to students in Plan A Thesis.

Research in engineering. Maximum credit six units applicable to a master's degree for students in Plan A only.

### **E E 798. Special Study (1-3) Cr/NC/RP**

Prerequisites: Consent of department chair.

Individual study. Maximum credit three units applicable to a master's degree for students in Plan B study.

### **E E 799A. Thesis or Project (3) Cr/NC/RP**

Prerequisites: An officially appointed thesis committee and advancement to candidacy.

Preparation of a project or thesis for the master's degree.

### **E E 799B. Thesis or Project Extension (0) Cr/NC**

Prerequisites: Prior registration in Thesis or Project 799A with an assigned grade symbol of RP.

Registration required in any semester or term following assignment of RP in Course 799A in which the student expects to use the facilities and resources of the university; also student must be registered in the course when the completed thesis or project is granted final approval.

### **E E 799C. Comprehensive Examination Extension (0) Cr/NC**

Prerequisites: Completion or concurrent enrollment in degree program courses.

Registration required for all students taking the comprehensive examination for the master's degree. Registration in 799C limited to two semesters.