Descriptions of Courses

▣ Undergraduate Program

EE105 Electrical Engineering: Changing the World
This course is designed to introduce Electrical Engineering (EE) to freshmen and to motivate them to join EE. To stimulate students' curiosity, we raise six interesting questions about EE topics, including computers, communications, circuits and semiconductors. Answers to these questions are provided via lectures and simple project activities.

CoE202 Fundamentals of Artificial Intelligence <Big data analysis and machine learning>
This course is designed to introduce basic machine learning techniques to 1st year undergraduate students in KAIST. The topics include linear regression, maximum likelihood and Bayesian techniques, logistic regression, support vector machine (SVM) and deep neural network. This is a self-contained course consisting of lectures and interesting in-class project activities using laptop.

EE201 Circuit Theory
The aims of this course are to make the student understand principles and fundamental concepts of circuit analysis; to develop the student's familiarity and understanding in modeling and analyzing circuits through a variety of real-world examples. Another important aim is to extend the student's ability to apply system analysis to other branches of engineering.

EE202 Signals and Systems
This course is an introduction to continuous-time and discrete-time signals and systems. The course covers Fourier series, Fourier transform, Laplace transform, and z-transform. Various types of systems with emphasis on linear time invariant system is studied.

EE204 Electromagnetics I
This course covers introductory electromagnetic fields and waves. Static electric fields and static magnetic fields are discussed. Time-varying fields and Maxwell's equations are introduced. Waves and transmission lines are studied.

EE205 Data Structures and Algorithms for Electrical Engineering
This course is to provide EE students with understanding and ability for design and implementation of data structure for problems solving in the EE area using computer programming. It deals with information representation using data abstraction, object-oriented programming, Algorithm analysis. Basic data structures to be covered are Array and Linked list, Stack and Queue, Tree, Graph, Sorting, and Hashing. Applications of such basic structures in EE problems using C++ are also covered.

EE209 Programming Structure for Electrical Engineering
This course covers data structures, algorithms, JAVA for electron electronics engineering. We study object-oriented programming techniques and use programming language C, JAVA.

EE210 Probability and Introductory Random Processes
In this course, we discuss such various topics in probability theory and introductory random processes as probability, random variables, expectations, characteristic functions, random vectors, random processes, correlation functions, and power spectrum. From time to time, homework problems will be assigned, usually not for mandatory submission.

EE211 Introduction to Physical Electronics
This course covers introductory material for semiconductor physics and semiconductor device physics. The course material starts from a discussion of crystal structure and progresses up to p-n junction. More specifically, the course covers the following topics: crystal structure of solids, principles of quantum mechanics, Schrödinger wave equation, energy band theory, statistical mechanics, carriers in

semiconductors, extrinsic semiconductor-donors and acceptors, carrier drift, carrier diffusion, carrier generation and recombination, ambipolar transport equation, excess carrier lifetime, p-n junction - equilibrium, p-n junction & applications.

EE212 Electronics Design and Practice
This is and introductory course on design for electrical engineers. Various topics in electrical engineering will be covered. This is course is suitable for second semester sophomores who took some basic core courses in electrical engineering.

EE213 Discrete Methods for Electrical Engineering
Much of the basic discrete mathematical tools useful in electrical and computer engineering will be presented, with applications. Students will learn actively the art of creating real-world proofs in these areas, preparing them for diverse regions of electrical and computer engineering such as communication, architecture, networking, algorithms, cryptography, etc.

EE214 Machine Learning Basics and Practices
This course is designed to teach basics and practices of machine learning mainly to 1st/2nd year undergraduate students. Every week consists of a lecture for learning basic theories and a practice session for coding to devise and implement algorithms. Emphasis is on developing hands-on experiences in designing various machine learning methods.

EE303 Digital System Design
This goal of this course is to understand the basic principles of digital logic circuit, and the fundamental concepts, components and operations of digital system.

EE304 Electronic Circuits
This course is an introduction to electronic circuits and the analysis and design of transistor amplifiers. First, the course extensively explains the basic operation principles of diodes, BJTs, and MOSFETs derived from physical structures and gives a concept of equivalent device models. Then, we will study the design and analysis of basic BJT and FET amplifiers and differential and multi-stage amplifiers. (Prerequisite: EE201)

EE305 Introduction to Electronics Design Lab.
Experiments related to electronics are performed. Focus is made for both hands-on experience and design practice. (Prerequisite: EE201, EE304)

EE309 Advanced Programming Techniques for Electrical Engineering
In this course, students will learn the internal architecture of the linux/unix operating system and how to design/implement complex system-level software in the C/C++ programming language. In this context, students will first learn about the detailed architecture of the linux operating system. Then, they will study the system level architecture of the file system and its management schemes. In addition, they will learn how to control/manage memory and operate processes and threads. (Prerequisite: EE209)

EE312 Introduction to Computer Architecture
The objective of this course is to understand the basic principles and hardware structures of computer systems including personal computers and workstations, and to learn how to design computers. This course covers data representation, CPU organization, instruction classification, language processing of assemblers and compilers, pipelining for performance enhancement, memory hierarchy, cache memory, and IO peripheral devices. In addition, high-performance computer systems are to be introduced.

EE321 Communication Engineering
This course is a brief introduction to random processes. Topics include: Basic operating principles and circuits of AM, FM, and SSB modulation/demodulation, PLLs, mixers and ADCs; Noise performance of communication systems; Introduction to digital communication techniques such as BPSK, FSK and QAM keying / detections. Issues related to multiple access techniques are covered. (Prerequisite: EE202)

EE323 Computer Network

This course will help the students learn how to design and implement computer networks, and their protocols, services, and applications. This course will include both principles and practice, but more importantly, is designed to let the students have hands-on experience. Most of the topics will be connected to the Internet, i.e., how the Internet works.

EE324 Introduction to Cloud Computing
This is an introductory networking course based on the Cisco Networking Academy Program and provides knowledge and practical experience with the design, configuration, management, and maintenance of computer networks. Topics include OSI 7-layer architectures, cabling, Ethernet, routing, TCP / IP protocols, IP addressing, routing protocols, WANs, network troubleshooting, and access control lists.

EE326 Introduction to Information Theory and Coding
This lecture provides a short introduction to essential topics in information theory for communication engineers. The topics include 1) measures of information and source, 2) Data compression, 3) Channel Capacity and Error Control Codes, 4) a very short description of rate distortion theory.

EE331 Introduction to Machine Learning

Introduces principles, algorithms and application of machine learning from the point of modeling and prediction; learning problem representation.
This course will cover concepts such as representation, over-fitting, regularization and generalization; topics such as clustering, classification, regression, recommendation problems, probabilistic modeling, reinforcement learning and various on-line algorithms. It will also introduce support vector machine and deep learning.

EE341 Electromagnetics II

In this course, time-varying fields and Maxwell's equations are introduced. Characteristics of the plane wave propagation depending on a medium are also covered. Then, transmission line theory which solves EM problems by means of electric circuit theory is also covered. Finally, the students learn how EM wave propagates in waveguides and over antenna. (Prerequisite: EE204)

EE342 Radio Engineering
This course is designed to provide a cohesive overview of fundamental topics required for the design and analysis of RF stages of the modern wireless communication circuits, components, and systems.
(Prerequisite: EE204, EE304)

EE352 Fundamentals of Photonics
The course will cover concept of photonics and photonic devices. Basic principles and their applications are introduced.

EE362 Semiconductor Devices
In this course, we study in depth how the basic semiconductor devices operate. Various semiconductor devices are examined including a pn junction diode, a bipolar junction transistor (BJT), and two-field effect transistors (MOSFET, JFET). This course will also cover non-ideal effects in the real semiconductor devices.

EE372 Digital Electronic Circuits
This course covers basic concepts of fabrication, operation and design techniques related with CMOS integrated circuits based on combinational / sequential logic blocks for arithmetic, logic and memory blocks. Also covered are such issues as timing, interconnect and design methodologies.

EE381 Control System Engineering
This course will cover general methods for analysis and design of the dynamic system. The main contents include modeling in the frequency and time domain, time response, reduction of multiple subsystem, stability, steady-state error, root locus technique, frequency response technique, and design via frequency response and state-space.
(Prerequisite: EE202)

EE391 Power Electronics Control
This course discusses the operational principles, analysis, modeling and design of power conversion circuits in power electronics and carried out Spice simulations. (Prerequisite: EE202)

EE402 Future Society and Electrical Engineering
This course is aimed at providing students with opportunities and skills for career planning and thus better preparing them for the future change in society by taking a look at technical trends in various areas of electrical engineering and the expected demands from the future society.

EE403 Analog Electronic Circuits
This course starts with the basic circuits for the design of BJT and CMOS amplifiers. The topics include the frequency response of amplifiers, feedback, an introduction to analog integrated circuits, various types of amplifier output stages, the study of analog filter, oscillator, and signal generators. (Prerequisites: EE201, EE304)

EE405 Electronics Design Lab.
In this design experiment laboratory, knowledge learned in many other courses in this division are brought to bear on performing a project combining analog / digital and hardware / software. Hence, a chipstone design experiment will be performed, which establishes synthesized application of undergraduate theory courses. For example, analog AM radio will be designed using various analog circuits, and voice recorder will be designed using Linux based embedded system.

EE411 Switching and Automata Theory
This course provides theory and technique for design and analysis of combinational / sequential digital circuits using discrete mathematics. Topics include: basics for set, relation and lattices; switching and boolean algebra, and switching function; combinational logic synthesis by functional decomposition; fault detection in combinational / sequential circuits; structure of finite state automata; automata-to-machine transformation; state and machine identification; properties of finite state machine with memory span; inverse machine; communicating finite state machine and systems verification; binary decision diagram and its application. (Prerequisite: EE303)

EE412 Foundation of Big Data Analytics
We Study introductory mathematical and programming tools for big data analytics, in particular focusing on recently successful real-world applications, e.g., web search, spam filtering, crowd-sourcing, visualization and recommendation system

EE414 Embedded Systems
In this lecture, various hardware and software components and system implementation aspects of embedded system are covered. Covered topics inlcude bus-based expandable ARM processor based board, open-source embedded Linux operating system, PC-based software development environment, digital and analog interface techniques, ARM assembly language, device drivers. Hands-on experience is gained to enhance firm understanding.
(Prerequisite: EE303)

EE415 Operating Systems and System Programming for Electrical Engineering
This course provides students with the knowledge and skills necessary to build a foundation in system programmings for Electrical Engineering, specially focused on operating systems and implementation. Topics include an overview of the components of an OS, concurrency, synchronization, processes, memory management, I/O devices, and file systems.

EE421 Wireless Communication Systems
This course emphasizes practical implementation aspects of digital communication systems. A physical-layer software implementation project will be assigned for a selected commercially-deployed communication system. Topics covered in this digital communication course include : (1) Digital modulation and demodulation, Optimum receivers, (2) Adaptive equalization and Synchronization, (3) Channel capacity, Error control codes. (Prerequisite: EE321)

EE424 Introduction to Optimization Techniques

The primary objective of this course is to present fundamental concepts and basic techniques of optimization with possible applications, which are essential for researches in circuit design, communications, signal processing, and control engineering. Topics include linear vector spaces and linear operators, linear estimation and filtering, functional analysis, optimal control, linear programming, nonlinear programming, dynamic programming, genetic programming (evolutionary computation), and neural networks.

EE425 Wireless Network

This course teaches the principles of wireless network access techniques and system applications. The main focus of contents covers wireless medium access techniques, multiple access control and scheduling, system capacity optimization, and their applications to WiFi, WiMax, and adhoc sensor networks.

EE426 AI Silicon Systems

As more industries are adopting artificial intelligence (AI) and machine learning (ML) technology, we are facing fast-growing demands for new types of hardware that enable faster and more energy efficient processing in relevant workloads. In this class, we will overview recent advances in AI/ML models, and study various AI silicon systems from both academia and industry. (Prerequisite: EE303, EE312, SS321)

EE432 Digital Signal Processing

This course studies the representation, analysis, and design of discrete-time signals and systems. Topics include a review of the z-transform and the discrete Fourier transform, the fast Fourier transform, digital filter structures, digital filter design techniques, analog-to-digital and digital-to-analog data conversion, rate conversion, sampling and aliasing issues. (Prerequisite: EE202)

EE441 Introduction to Fiber Optic Communication Systems

This introductory course is intended to familiarize students with underlying principles of fiber optic communication systems. Topics include an overview of fiber optic communication systems, optics review, lightwave fundamentals, light detectors, noise analysis, and system design, etc.

EE450 Technology Entrepreneurship

Technology entrepreneurship has an important role both in training entrepreneurship and emphasizing the importance of venture business to students majored in science and engineering. The level of understanding on real-life venture businesses will also be enhanced through case studies.

EE451 IT venture start-up

This course covers key issues in initiating an IT venture startups including business idea development, business model, growth strategy, business plan, and fundraising strategy. Students work in teams throughout the semester in simulating venture formation, which ends up with business plan presentation at the end of the semester.

EE453 Understanding of Optoelectronic Devices

Based on basic concepts in semiconductor physics, this course covers fundamental principles of optoelectronic devices, such as semiconductor-based light emitters and photodetectors, for modern photonics and optoelectronics applications.

EE463 Semiconductor IC Technology

Technology for Silicon Semiconductor IC (Integrated Circuit) chip which is the basis of modern electronic systems, will be covered, focusing on its historical background, structures of modern semiconductor devices, and fabrication processes. Current and future trends of semiconductor IC technology will also be discussed.
(Prerequisite: EE211, EE362)

EE464 Electrical Engineering for Green Energy

This course will teach students the fundamental principles and concepts for electric power system with an emphasis on renewable energy technologies that are important from the perspectives of electrical engineering.

EE465 Heterogeneously Integrated Semiconductor Devices

This course aims to provide a broad viewpoint about 3D stacked and heterogeneously integrated semiconductor devices and its history. It will include how to fabricate those devices and its potential applications such as CMOS, Si photonics, Image sensors, MicroLED displays, etc. At the same time, related fundamental device physics will be introduced. (Prerequisite: EE211, EE362)

EE466 Introduction to Biomedical Electronics
This course will introduce elementary concepts of biomedical electronics and guide students how to apply their electrical engineering skills to solve problems in medicine and biology. Topics include biomedical sensors, nano-bio sensors, nano-bio actuators, bio-inspired devices for medicine, non-invasive and ubiquitous body sensing, and their clinical applications.

EE467 Sensor Electronics
Tremendously many kinds of sensors are being used in modern engineering systems, and they are directly connected to the electronic devices or systems. This course primarily emphasizes the fundamentals of measurements, sensors and their interfaces to the electronic systems. (Prerequisite: EE211)

EE468 Thin Film Transistor
This lecture deals with a key element such as thin film transistor (TFT) for thin film electronics, being the most important device on flat panel display applications as well as 3D stackable semiconductor devices. In this course, we shall start with fundamentals and a concise historical perspective. Then, we will learn about structure, fabrication and transistor characterization. Additionally, taking into account that the semiconductor for TFT is made of thin film process, we shall explore TFTs with various thin film semiconductors (amorphous Si, poly-Si, and electronically active oxide semiconductor). (Prerequisite: EE212, EE362)

EE469 Brains, Machines, and Societies
Recent advancement in A.I. and machine learning requires us to think more systematically about what it means for a machine to be “intelligent”. How is human intelligence based on biological brain different from artificial intelligence? And also: what are the societal implications of A.I.?

EE473 Semiconductor Nanostructures
This course covers the theoretical framework for understanding the electronic properties of quantum confined devices, such as semiconductor heterostructures, two-dimensional materials, quantum wires, and quantum dots. Along with the fundamental principles, the course discusses operational characteristics of nanoscale electronic devices. (Prerequisite: EE211,EE362)

EE474 Introduction to Multimedia
This course introduces students to the variety of media elements including text, graphics, sound, video, hardware and software components and the necessity for interactivity in multimedia as well. By introducing associate fundamental technologies, the course aims to help and encourage students to develop their imaginative and creative skills using multimedia. (Prerequisite: EE202)

EE476 Audio-Visual Perception Model
This course teaches the principles of wireless network access techniques and system applications. The main focus of contents covers wireless medium access techniques, multiple access control and scheduling, system capacity optimization, and their applications to WiFi, WiMax, and adhoc sensor networks.

EE477 Database and Big Data Systems
This course is on the design and implementation of database and big data systems. The first part covers database design and usage. The second part covers the internals of database systems and recent NoSQL and NewSQL systems.

EE478 Introduction to Multi-disciplinary Robot Engineering
In this course, a broad and practical overview for robotics is given in a multi-disciplinary perspective. Key principles such as coordinate transformation, navigation, control, motion planning, and decision making are taught. Recent advances in drons, self-driving cars, and AI for robotics are also introduced.

EE479 Scientific Computing and Data
This course surveys scientific computing and data science methods relevant for physical electronics. First, traditional numerical analysis methods for the solution of ordinary and partial differential equations will be presented. Next, machine learning approaches and their mathematical basis will be surveyed in view of a modern numerical analysis framework.

EE480 Basics of Quantum Information and Quantum Computing
The course begins with the quantum logic and aims to deliver how quantum advantages can be achieved in communication and computational tasks. Examples of quantum algorithms and quantum protocols are provided. Known approaches to implement quantum information processing are explained.

EE481 Intelligent Systems
Two major themes of this course are 'Modern Control System' and 'Computational Intelligence'. Each lecture will address a balanced emphasis on the theory about the control system and its applications in practice. The first part of this course includes digital control system design and state-space methods for control system design. The basic system identification scheme will also be included, considering the control of unknown systems. Once background knowledge of the modern control system is established, this course will then focus on the second part composed of computational intelligence using fuzzy logic, artificial neural network and evolutionary computation as main topics to introduce recent trend in intelligent control. Term projects will be assigned to test the algorithms to the given problems. (Prerequisites: EE381)

EE485 Special Topics in Electronic Engineering I

EE486 Special Topics in Electronic Engineering II
Special topics in electrical engineering for new theoretical and applied fields will be covered in this lecture that involves a suitable subtopic(s).

EE488 Special Topics in Electronic Engineering
This course covers topics of interest in electrical engineering at the undergraduate level. The course content is specifically designed by the instructor.

EE490 B.S. Thesis Research
In this course, the student selects an advisor and a research topic, and conducts research to expand his basic understanding and application regarding a specific research topic in electrical engineering.

EE495 Individual Study
In this course, the student select an advisor and a research topic, and conducts research for basic understanding and application of a simple specific topic in electrical engineering.

EE496 Seminar
This course is composed of invited lectures from experts in electrical engineering and various areas.

▣ Graduate Program

EE509 Technical Writing
This course addresses essential elements in how to write a good research/technical paper. The elements contain a right understanding of graduate studies, a method of doing good research and good presentation, how to note a memo, writing a patent, writing a technical paper, and case studies.

EE511 Computer Architecture
The goal of this course is to understand the principles and organization of computer systems, and to learn the performance enhancing techniques and quantitative analysis methods used in advanced processors. This course covers high-performance techniques such as pipelining and out-of-order processing, memory hierarchy including cache memory and virtual memory, interrupt processing, and how to design a processor based on quantitative analysis. In addition, recent important topics such as SIMD and multiprocessors will be introduced and a design and simulation for a virtual processor is to

be practiced for a comprehensive understanding of computer systems.
(Prerequisite: EE303, EE312)

EE513 Networked Systems and Security
Lecture on operating system and network system handles network middleware. Network middleware is a distributed software layer that works above the network operating system and below the application layer and abstracts the heterogeneity of the underlying environment. The role of middleware in network systems will become increasingly important, especially in emerging technology areas such as mobile computing where the integration of different applications and services from different wired and wireless networks becomes important. Since a middleware is represented with providing useful building blocks for the construction of software component, the lecture will introduce basic principles, architectures, interactions in distributed system, and a broad sense of content in the computing infrastructure.

EE514 Parallel Computer Architecture
In this course, we will learn the notion of locality, parallelism and hierarchy and how these concepts are utilized in designing the processor, interconnection network, and memory/storage subsystem of modern high-performance parallel computer architectures such as CPUs and GP-GPUs. Based on the understanding of these parallel computer architectures, we will explore how these systems can be programmed using parallel programming language models, followed by a discussion on their use-cases in designing domain-specific architectures for certain target application domains. (Prerequisite: EE312)

EE515 Security of Emerging Systems
Every scientific research starts from finding new problems. Likewise, the most important step in security research is to discover new attacks. Today, media is filled with attacks on various systems: Web servers, DNS, Internet banking, e-voting systems, cellular networks, social networks, mobile phones, nuclear power plants, and implantable medical devices. These attacks are originated from various vulnerabilities, such as user interface design, ignorance or security by obscurity, deployment mistakes, and physical exposure. The main objective of this course is to learn how to think like an adversary. In other words, we will look at various ingenuous attacks and discuss why and how such attacks were possible. This is first crucial step to design and deploy systems robust against various attacks.(Prerequisite: EE323, EE415)

EE516 Embedded Software
This lecture covers the topics of embedded software programming including Linux basic commands, shell programming, kernel structure, interprocess commuication, file system, device drivers, and bootloader structure. Each students will practice to implement the lectured topics on a embedded computer to be a real embedded system programmer. (Prerequisite: EE209)

EE517 Software Hacking Theory and Practice
This course covers software vulnerabilities, exploit mitigations, and advanced techniques for writing exploits. Following the historical order of arms race in cybersecurity, this course gradually introduces complex concepts in software security. Students will have hands-on experiences by playing Capture-The-Flag (CTF), which attacks a variety of vulnerable software in an emulated environment. (Prerequisite: EE209)

EE520 Telecommunication Networks
Topics covered in this course include layered network architecture, open system interconnection (OSI), and various network protocols, such as Ethernet, Token Ring, FDDI, DQDB, X.25, Frame Relay, SMDS, Internet, telephone network, signaling network, and ATM network.

EE522 Communication Theory
Fundamental principles and mathematical bases underlying digital communication systems are introduced. Topics include MAP detection theory, optimum receivers, information theory, coding theory and diversity techniques.
(Prerequisite: EE421)

EE523 Convex Optimization Techniques

The main goal of this course is to present advanced topics of convex optimization which are essential for researches in communications and networks, estimation and signal processing, data analysis and modeling, statistics and finance, electronic circuit design, automatic control and industrial engineering and to deal with their application areas. We study the primal-dual interior point method, semi-definite programs and second-order cone programs.

EE527 Data Communication

This is a graduate level course on data communication. The first half of the course involves an overview, data transmission and data communication network. The latter half of the course involves internet protocol, internet service and wireless internet.

EE528 Engineering Random Processes

In this course, based on the fundamental concepts and knowledge addressed in EE210, we discuss advanced topics in probability and random processes for applications in engineering. Topics includes algebra of sets, limit events, random vectors, convergence, correlation functions, independent increment processes, and compound processes. (Prerequisite: {EE210} or {Approval of the Instructor})

EE529 Wireless Communications

This course, as an advanced course of EE 421, aims at providing a strong foundation for research in the are of wireless communications. The course will address (1) wireless channel models from a system theoretic viewpoint, (2) modulation and demodulation in wireless channels, (3) coding techniques for wireless channels, (4) various equalization techniques for ISI channels, (5) multicarrier transmission techniques including OFDM, (6) spread spectrum technique (DS, FH), and (7) MIMO communications with a focus on single user MIMO.

EE531 Statistical Learning Theory

Introduce students the fundamental concepts and intuition behind modern machine learning techniques and algorithms, beginning with topics such as perceptron to more recent topics such as boosting, support vector machines and Bayesian networks. Statistical inference will be the foundation for most the algorithms covered in the course.

EE532 Introduction to brain IT

This course will discuss the key differences in architecture and algorithms between conventional information processing systems (e.g. von Neumann machines) and biological brains. Subsequently, we will try to come up with the scaffold of a basic design for a non von Neumann type of brain-like information processing system.

EE533 Digital Speech Processing

This course explains how digital signal processing techniques can be applied in the field of speech communication. The initial part of the course covers some background material in signal processing and the acoustic theory of speech production. Later lectures cover coding, recognition and synthesis of speech. (Prerequisite: EE202)

EE534 Pattern Recognition

This course handles underlying background theories for pattern recognition (PR) which is the start point for AI. It covers PR systems, Bayesian Classifier, likelihood-based PR, Discriminant Fuction-based PR, Support Vector Machine, NN-based PR, and other PR theories such like fuzzy theory, and so on.

EE535 Digital Image Processing

This course deals with the fundamental concept of digital image processing, analysis, and understanding. Topics include sampling, linear and nonlinear operations of images, image compression, enhancement and restoration, reconstruction from projections, feature extraction, and image understanding.

EE538 Neural Networks

This course covers the theory and application of neural networks. In particular lectures explore the structure and function of neural networks and their learning and generalization. Also various models of

neural networks and their applications are illustrated.

EE539 Nonlinear Statistical Signal Processing
This course is to allow the students majoring in the general areas of communications and signal processing (and those in other areas also) to obtain the basic and advanced knowledge of statistical techniques for signal processing. Topics include multivariate distributions, order statistics, and their applications. The key concepts, theory, and methodology of nonlinear techniques for statistical signal processing are studied. (Prerequisite: EE528 recommended)

EE541 Electromagnetic Theory
This course is designed to treat electromagnetic theory with applications in wave-guides and antennas. The course will start with Maxwell's equations and show how to apply Maxwell's equations to the basic electromagnetic wave phenomena.

EE542 Microwave Engineering
This course is designed to provide in-depth understanding and knowledge on the theory and applications of microwave circuits, components, and systems used in Microwave and RF wireless communication systems. (Prerequisite: EE204)

EE543 Antenna Engineering
This course mainly deals with general theories and applications for antenna and antenna system. The main topics are including an introduction to antennas, analysis and synthesis of antenna elements and arrays, microstrip antennas, active phased array antenna, and smart antenna techniques.

EE546 Fields and Waves
This course covers fields and sources in wave-guides, coupled mode theory, and wave propagation in periodic structures and anisotropic media. Green's functions and their applications to radiation and scattering of waves are extensively considered.

EE547 Introduction to Quantum Information Processing

Quantum Computing is a newly emerging technique to manipulate information to solve mathematically complex problems. This course teaches the fundamental understandings of the quantum information theory and its application with quantum computing algorithms at an entry level. The class will be concluded with discussions on quantum bit system technologies.

EE548 Matrix Computations for Signal Processing
This course deals with various matrix computation algorithms for signal processing such as linear system solving, matrix norm, positive-definite matrix. Toeplitz matrix, orthogonalization/diagonalization, eigen-value problems, SVD (singula value decomposition), iterative methods for linear systems, and so on.

EE552 Quantum Computing Algorithms and Applications
This course introduces the fundamental understandings of quantum computing and algorithms for applications with quantum simulations and quantum AI. This course teaches the fundamental understandings of how quantum computing can outperform digital computing by reviewing the basic principles of quantum computing and its algorithms, and discusses about the practical quantum computing models and their applications. Students are required to have backgrounds in, or similar to, Physical Electronics (EE211) or Modern Physics (EE565). (Prerequisite: EE211, EE565)

EE555 Optical Electronics
This course covers propagation of lightwave in isotropic and anisotropic media, Gaussian beams, interaction of matter and light, principles of lasers, modulation and switching of light, and nonlinear optical phenomena.

EE557 Coding Theory
This course provides fundamentals on techniques for error-correction or detection. In this course, students study the basics of Finite Field Theory to understand algebraic codes, and based on this, they comprehend cyclic codes, BCH codes, Reed-Solomon codes. In addition, they acquire knowledge about channel codes defined on graphs, such as Convolutional codes, Turbo codes, Low-density Parity-check (LDPC) codes. This course also provides a short introduction to signal space codes.

EE561 Introduction to VLSI Devices
This course covers fundamental VLSI device physics for graduate students. After a brief review of basic quantum mechanics and semiconductor processes, the lecturer will cover basic principles of operation in semiconductor devices including PN junction, MOS Capacitor, MOSFET and bipolar transistors with a strong emphasis on deep submicron secondary effects of MOSFET and bipolar transistors for extensive understanding of advanced device engineering. (Prerequisite: EE362)

EE563 Display Engineering
In this course, the technology trend of the next generation information display devices will be introduced and their basic principles will be studied. In particular, LCD, PDP, OLED, and FED are mainly discussed.

EE565 Modern Physics for Engineers
This course primarily emphasizes “quantum mechanics“ and “statistical physics“ for engineers. Quantum mechanics includes a history of quantum physics, Schrödinger equation, concept of wavepacket, and N-degrees of freedom. Statistical physics covers a motivation, concept of ensemble average, Boltzmann distribution, Bose-Einstein distribution, Fermi-Dirac distribution, and Non-Equilibrium statistics.

EE566 MEMS in EE Perspective
In this course, we will discover microelectromechanical systems (MEMS) in electrical engineering perspective, touching a complete set of design, fabrication, and applications. With respect to designing MEMS, we will explore various working principles, CAD tools including semiconductor design tools, and signal processing circuits. Also, core semiconductor processing technologies and a wide range of micro-machining techniques are studied in depth, in order to fabricate MEMS. We will address important issues in major fields of MEMS applications, including microsensors, RF / microwave, optical, and bio / microfluidic MEMS, specially in an electrical engineering viewpoint.

EE567 Photovoltaic Power Generation
In this course, various photovoltaic devices and systems are introduced. This course deals with basic theory of solar cells, the structures and characteristics of various solar cells, and the recent R&D trend and future prospects of photovoltaic technologies. (Prerequisites: EE211)

EE568 Introduction to Organic Electronics
In this course, students will get familiar with the fundamental principles behind electronic/ photonic properties of organic materials, and will learn how those principles can be built into real-world devices such as organic light emitting diodes (OLED), solar cells, and field-effect transistors. Upon completion, students will be able to build a solid foundation that they can later apply to real engineering problems in related areas.

EE569 Nanobioelectronics
It covers interfacial phenomena occurring in a hybrid system of semiconductors and biomolecules, elementary biological materials, fundamentals of MOSFET, nanofabrication techniques, manipulation technology of bio-molecules based on nanobiotechnology, aqueous solutions, solid-liquid junctions, Lab-on-a-Chip, biosensors, and Bio-MEMS technology.

EE571 Advanced Electronic Circuits
This course introduces new analysis methods for analog-circuits implemented by using bipolar and MOS transistors. Since the design of analog circuit requires both approximation and creativity, this course explains how to approximate and design complicated circuits. (Prerequisites: EE304, EE403)

EE573 Introduction to VLSI Systems
This course covers the role, application and various issues in the design and verification of various VLSI chips including SoC (System-on-Chip). Additional topics include HW / SW co-design and co-verification, full-custom design, reconfigurable systems, low-power system, interconnection and packaging, clock distribution, VDSM (Very Deep Submicron) issues. Students will be given two opportunities for poster and oral presentations, respectively, on the topic of his / her choice within the course subject.

EE574 Computer Aided Design of VLSI Circuits and Systems
This course covers basic concepts and algorithms for CAD and design methodology for VLSI circuits and systems including automatic synthesis at various levels of abstraction, timing analysis and timing closure, and testing and testable design.

EE575 Entertainment Platform
This lecture covers the H/W and S/W architectures of Entertainment Platform(EP). The issues of CPU, GPU, HCI, Entertainment engine, OS, Networks, Entertainment Systems, Smart Phone Programming, Graphics, Animation, VR, Affective Computing will be discussed in detail.

EE576 Low Noise Electronic Circuits
This lecture covers the H/W and S/W architectures of Entertainment Platform(EP). The issues of CPU, GPU, HCI, Entertainment engine, OS, Networks, Entertainment Systems, Smart Phone Programming, Graphics, Animation, VR, Affective Computing will be discussed in detail.

(Prerequisite: EE403)

EE581 Linear Systems
Topics include system representation (input-output description, state variable description), solutions of linear dynamical equations, controllability and observability, irreducible realization, stability (BIBO stability, Lyapunov stability) for rigorous treatment of linear systems. In addition, feedback linearization is to be covered.

EE582 Digital Control
This course describes the analysis and design of digital control systems. Sampling and data reconstruction and Z-transform in computer control system will be covered. Analysis and design of digital control systems using frequency domain techniques will be introduced. Also, design of the digital control system using state space approaches will be covered. As a term project, a real-time digital control system will be implemented on a microprocessor system.

EE585 Mobile Robotics and Autonomous Navigation

This course helps students understand the cutting edge mobile robotics technologies focusing on autonomous navigation and SLAM (Simultaneous Localization And Mapping) by performing simulations in Webots and ROS (Robot Operating System) environment.

EE591 Introduction to Electric Vehicles

This course introduces electric vehicles consisting of two major subtopics: general knowledge of vehicles (chassises, drivetrains, electronics control units, and etc.) and electric vehicle E/E (electrical and electronics) architectures (electric motors, drivers, batteries, BMS, etc.).

EE595 Special Topics in Electrical and Computer Engineering
This course covers topics of interest in Electrical and Computer Engineering at the graduate level. The course content is specifically designed by the instructor.

EE612 Discrete Event System Modeling and Simulation
This course provides theory and practice for modeling and simulation of discrete event systems which include communication networks, manufacturing systems, and high level computer systems. Topics include system taxonomy and discrete event systems (DES) characteristics; three entities in modeling and simulation; model representation and formalism construction; DEVS (Discrete Event systems Specification) formalism and DES modeling; simulation algorithm for DES; Petri Net modeling and analysis; statistics for modeling, simulation and analysis; model validation; output analysis and performance evaluation; advanced topics in DES modeling and simulation.

EE613 Distributed Computing Systems
Distributed computing systems have become pervasive. From clusters to internet-worked computers, to mobile machines, distributed systems are being used to support a wide variety of applications. This course introduces key concepts and techniques underlying the design and engineering of distributed computing systems. The following are the objectives of this course:

- In depth understanding of core concepts of distributed computing.
- Construction of applications and supporting system components by doing project work.

EE614 Service Oriented Computing Systems
Many of key technique now being applied in building services and service-based applications were developed in the areas of databases, distributed computing, and multiagent systems. These are generally establishedbodies of work that can be readily adapted for service composition. Lecture on service oriented computing will cover the principles and practice of service oriented computing. Especially, it introduces architecture, theories, techniques, standards, and infrastructure necessary for employing services.

EE616 Advanced Big data - AI Integration

This course covers advanced research topics in Big data - AI Integration, which is at the intersection of data management, machine learning, and systems. Each week, students will take turns presenting recent papers in each topic in a seminar format or submit short reviews. Students will also write surveys on recent papers of interest and implement state-of-the-art methods based on them.

EE618 Advanced Computer Networking and Cloud Computing

This course covers advanced research topics in computer networking and cloud computing. The course is designed to cover various topics in the broad areas of computer systems, networking, cloud and mobile computing, including issues such as wide-area networking, congestion control, data center networking, software-defined networking, network functions virtualization, distributed systems, systems for machine learning, and data intensive computing.

EE619 Mathematical Foundations of Reinforcement Learning

The subject of this course is sequential decision making under uncertainty in a system whose evolution is influenced by decisions. The decision made at any given time depends on the state of the system and the objective is to select a decision making rule that optimizes a certain performance criterion. Such problems can be solved, in principle, using the classical methods of dynamic programming.

EE622 Detection and Estimation
The purpose of this course is to provide the fundamental background behind detection and estimation theories based on likelihood functions as well as on Bayesian principles. Topics to be covered are decision theory, hypothesis testing, performance analysis, detection and estimation from waveform observation, linear and nonlinear parameter estimations. (Prerequisite: EE528 recommended)

EE623 Information Theory
This course covers the core concept of information theory, including the fundamental source and channel coding theorems, coding theorem for Gaussian channel, rate distortion theorem, vector quantization, multiple user channel and multiple access channel.
(Prerequisite: CC511, EE528)

EE624 Cellular Communication Systems and Protocols
This course deals with cellular communication systems, the structure of cell phone systems, access technology, wireless communication radio, fading issues, diversity, link analysis, CDMA diffuse spectrum system, physical/data link/network layers, traffic control, mobile network structure and 3rd generation mobile communication systems.

EE626 Advanced Communication Theory
This course is meant to provide a strong foundation for graduate study and research in the area of communications. The main objective of this course is to fortify the understanding of advanced communication theories required to design and analyze digital communication systems, especially for memory channels

EE627 Performance Analysis of Communication Networks
This course focuses on advanced techniques for control, modeling and performance analysis of high-speed communication networks and the Internet. Traffic, network queueing, quality of services, various network algorithms and protocols are quantitatively analyzed and discussed.

EE628 Video Compresseion and Applications

Video compression is very importantly and widely deployed in Smart Phones, DTV/UHDTV, Digital Cameras/Camcorders, etc. This class aims at providing students with the comprehensive overview of the principles and algorithms employed in image and video compression. A particular course objective is an in-depth understanding of the rationale behind the frame-based video coding such as H.264/AVC (Advanced Video Coding) as well as HEVC (High Efficiency Video Coding). (Prerequisite: EE432)

EE631 Advanced Digital Signal Processing
This course aims to learn fundamental technologies for signal modeling and estimation and covers deterministic and random signal modeling, lattice filter realization, parameter and signal estimation, Wiener and Kalman filter design, parametric and nonparametric spectrum estimation, and adaptive filtering. (Prerequisite: EE432, EE528)

EE635 Functional Brain Imaging
The primary objective of this course is to discuss what NeuroImaging methods are available to study the brain. The focus of the course will be on modern tools capable of whole-brain imaging (mostly MRI), but we will also discuss non-MRI techniques as well. As part of the term project, students will be ask to propose novel acquisition and/or analysis method that are likely to facilitate our ability to understand the brain.

EE636 Digital Video Processing
This course provides basic theory and techniques for the representation and processing of digital video. Topics include digital video formats, video spatio-temporal Sampling, 2-D/3-D motion estimation, motion segmentation, digital video filtering, video enhancement, video compression, and digital video system. In addition to the theory, students suppose to participate in experiments that are related to the above topics.

EE637 Speech & Audio Coding Theory
This course offers the basic mathematical backgrounds and implementation techniques of not only recent mobile speech coding methods including CELP but also audio coding techniques such as MP3 and AAC. In addition, we study the trends for convergence of speech and audio coding techniques. (Prerequisite: EE432)

EE639 Neuro-Robotics

The primary objective of this course is to explore the synthetic modeling approach to understand brain-based mechanisms for learning and generating sensory-motor behaviors. For this purpose, the course will offer introduction of neuro-robotics studies as well as neuroscience literatures related to brain mechanisms for sensory perception and behavior generation. In addition, the course will offer hand-on experiences on experimenting neuro-driven learnable robots in the instructor's lab. The course will gain a good understanding on mechanisms for learning and generating cognitive behaviors both in biological brains and artifacts. Evaluation is based on quiz during class, term project and active class participation.

EE641 Monolithic Microwave Integrated Circuits
Key elements of microwave/RF ICs for wireless systems including mobile communications and radars are covered. Subcircuits including low noise amplifier, mixer, voc, power amplifier, switches, phase shifter, and digital RF blocks are studied with their design methods, modeling methods, and characterizing methods. (Prerequisite: EE204, EE304)

EE643 Millimeter-wave Integrated Circuit (mmWIC) Design
This course is designed to provide graduate students with design capability of the millimeter-wave and terahertz integrated circuits and application systems. The course starts from the active/passive device models for active and passive circuits on silicon. On-chip antenna, Beam-forming and radar blocks will be also studied for multi-Gbps wireless communication and wireless sensor applications.

EE645 Wireless Transceiver Systems
RF signals in modern wireless systems are basically based on digital techniques. To understand the architectures and be able to specify the parameters of the modern RF transceiver systems, fundamental concepts both on digital and RF are necessarily understood. This course gives the basic concepts and technologies related to modern digital radio transceiver systems.

EE647 Nano-Photonics
The course will cover photonic properties of nanoscale structures and devices. Basic principles and their applications are introduced.

EE650 Optimization in Communication Network
The course covers parallel and distributed algorithms for optimization problems with special emphasis on the application of these algorithms to various communication network algorithms such as distributed power control, flow control and routing. In particular, asynchronous algorithmic models are emphasized.

EE652 Fiber-Optic Communication
This course involves the fundamental principles for understanding and applying fiber optic technology to modern telecommunication systems. This course starts with a brief review of telecommunication network, and covers various aspects of fiber optic communication technology including the fundamentals of fiber optic waveguides, signal degradations, photodetection, optical receiver design, fiber optic link design, and amplified WDM systems.

EE654 MIMO Wireless Communications
The course mainly covers the effective use of multiple-input multiple-output (MIMO) antennas in wireless communications in order to enhance the system capacity and the link reliability. It also covers the review of basics in wireless communication systems, diversity gains, power gains, degree of freedom gains, and multiplexing capability of MIMO systems, the capacity of MIMO channel and the opportunistic communication for a fast fading channel, MIMO transmitter/receiver architectures, the outage performance, diversity-multiplexing tradeoff, and universal space-time codes for a slow fading channel, and the role of multiuser MIMO channel in uplink and downlink

EE655 Economics in Communication Network
This lecture provides economic tools to understand various mechanisms, algorithms, protocols in communication networks. The main tools include game theory, auction theory, and many examples based on the recent papers are introduced and discussed.

EE657 Local Area Network/Metropolitan Area Network (LAN/MAN)
This course provides the broad view of network architecture and protocol at local area network and metropolitan area network (LAN/MAN). We focus on design concept of LAN/MAN with user and operator viewpoints (e.g., cost, complexity, and performance). Topics include all the IEEE 802.x series including 802.3x (Ethernet), 802.11x (Wireless), 802.15 (Cable), 802.16x (Wibro/WiMax), 802.17 (RPR), 802.21 (MIH), etc. In addition, virtual private network (VPN) and passive optical network (PON) are investigated.

EE658 Queueing theory with applications
The course briefly deals with fundamental stochastic processes such as Poisson, renewal, discrete-time Markov chain, continuous-time Markov chain, IBP, IPP, MMBP, MMPP, self-similar process. The course then covers various queueing systems and their applications such as Markovian BD queues, advanced Markovian models, M/G/1 priority queue, M/G/1 retrial queue, and M/G/1 queue with vacation.

EE659 Wireless Communication Protocols and Analysis
This course teaches the principles of wireless network access techniques and system applications. The main focus of contents includes wireless radio resource management such as medium access techniques, power control, handoff and scheduling. Optimization of wireless systems in terms of capacity and efficiency is addressed and their applications to WiFi, WiMax, and ad hoc/sensor/mesh networks are provided.

EE661 Solid State Physics
The course will cover basic physics and applications of various solid state materials such as metals, semiconductors, dielectrics, thermoelectric materials, and magnetic materials. Also are included the various physics of nanostructures such as quantum well, quantum wire, quantum dots.

EE663 High Frequency Electronic Devices
This course aims to give an understanding of the fundamental principles and technological developments in high-frequency electronic devices for microwave and high-speed digital / analog electronic systems and applications. (Prerequisite: EE362)

EE664 Applied Optics for Display Devices
This course will cover the basic concept for optical technologies that can be important for display devices and their characterization. Students will acquire a solid knowledge of practical optical technologies that can become an important foundation for further study in display or related fields.

EE665 CMOS Front-end Process Technology
This module covers essential process steps in CMOS IC fabrication, focusing on front-end process technology including gate module, shallow junction module, thin film deposition, interconnection, and patterning technology. The students also develop understanding on physical background of each unit process as well as integration issues in modern CMOS devices. Recent developments on front-end processing are also covered.
(Prerequisite: EE211, EE362)

EE666 Optoelectronic Semiconductor Devices and Their Applications
The purpose of this course is to provide the basic principles and technological developments in semiconductor optoelectronic devices and their applications. This lecture covers optical properties of semiconductor materials, operating principles of semiconductor light sources, photodetectors, and image sensing devices along with recent research trends as well as their system applications, such as high-speed optoelectronic signal processing and passive/active optical image sensing.(Prerequisite: EE362)

EE667 Multiple View Geometry.
This course deals with fundamental concepts of multiple view geometry for 3D computer vision, such as projective geometry, transformation, estimation of the transformation parameters, camera model and camera matrix, epipolar geometry, fundamental matrix, trifocal tensor, and 3D Structure computation, and so on.

EE672 Future and Technology: New Media technology and Business Strategies
The course will essentially provide basis of marriage between social sciences and engineering capabilities of students, hence: 1)Link understanding between future-oriented Business and Technology Strategies in Media and Broadcasting, 3)Emphasize importance of user considerations when identifying and designing disruptive technological solutions for future media society

EE675 Digital Computer Atithmetic: As the hardware complexity and power consumption of a digital system are critically affected by computer arithmetic methods, it is important in VLSI design to understand arithmetic processing methods. This class deals with diverse number systems, hardware computing structures, and detailed arithmetic methods for high-speed and low-power operations

EE676 Analog Integrated Circuits
This course deals with advanced level of analog circuits emphasis on CMOS. The topics include wideband operational amplifiers, comparators, Switched capacitor filters, ADC, DAC, continuous time filters, etc. (Prerequisite: EE571)

EE678 Digtal Integrated Circuits
This course is designed to expose students to the important issues in high performance CMOS circuit design. This course covers the data path design in full custom design methodology, clocking strategy, and the state-of-the art CMOS logic styles.

EE681 Nonlinear Control
This course is intended to present the fundamental result of analysis and design of nonlinear control systems. Especially, this course is concerned with the analysis tools for nonlinear dynamical systems and the design techniques for nonlinear control systems. (Prerequisite: EE581)

EE682 Intelligent Control Theory
Among the various well-known intelligent control techniques, the methods of fuzzy control and neural net-based learning control are first introduced to allow for handling ambiguous / uncertain situations and effective supervised learning, respectively. Specifically, the theory of fuzzy sets and fuzzy logic-based inference mechanism are studied and the design techniques of fuzzy control are introduced. Then, the neural net learning structure is discussed and the control system based on the artificial neural nets is studied. Fuzzy-neuro systems are also considered. In the second part of the course work, some other computational intelligence techniques such as GA and the rough set are briefly covered and then the basic machine learning techniques and the reinforcement learning method are studied in conjunction with the their use in control system design. (Prerequisite: EE581)

EE683 Robot Control
This course is intended to cover kinematics, dynamics and control algorithm of robot manipulator. After covering homogeneous transformations, kinematics equations, motion trajectory planning, we will handle various control methods. We will compare the utilization of these control methods through simulation.

EE688 Optimal Control Theory
This course deals with the derivation of maximum principle and the design of optimal control system. It includes an optimal design method for minimum time and energy along with dynamic programming and discrete maximum principle. Also advanced topics of optimal control are introduced. (Prerequisite: EE581)

EE691 Telecom. Network Management
The lecture on network management will introduce the key issues in the communications network management and will cover a new paradigm encountered in managing communications network.

EE692 Parallel and Distributed Computation in Communication Network
This course covers mathematical theories associated with computation, convergence, communication and synchronization of parallel and distributed algorithms which often appear in network, communication, control, signal processing and OR problems, focusing on asynchronous parallel and distributed algorithms. System of equations, nonlinear optimization, variational inequality problem, shortest path problem, dynamic programming, and network flow problem will be addressed as applications with many real-world examples.

EE696 Telecommunication Software Design
The design and implementation of physical layer, data link layer and network layer protocols are explained. Also, client / server programming using UNIX and windows sockets is studied. Moreover, the architecture of SDR based terminal is investigated. Finally, this course involves protocol design, verification and optimization.
(Prerequisite: EE527)

EE722 Advanced Signal Detection
This course is to discuss some important advanced topics in the area of signal detection theory. Topics may vary: In Fall 2005, the main topic will be locally optimum detection of weak signals.
(Prerequisite: {EE528 and EE622} or {Approval of the Instructor})

EE727 Broadband Network Design and Analysis
This course provides performance analysis of the existing and future network according to ISO/OSI 7 layer model. We focus on performance of network systems (switch, router, server/gateway, wireless) and their protocols. Topics include mathematical approaches on flow control, routing, polling, and scheduling algorithm by using queueing theory. Operational analysis and OPNET simulation are compared with numerical results.

EE731 Adaptive Signal Processing
The course covers fundamental theories and key techniques for applications in adaptive signal processing. More details are signal modelling, optimal estimation theory, Wiener and Kalman filters, eigen-filters, LMS/RLS algorithms, and their variants. We also deal with advanced topics such as adaptive equalization, adaptive beam-forming and adaptive interference cancellations. (Prerequisite: EE432, EE528)

EE733 Multirate Signal Processing
This course introduces fundamentals of multirate digital signal processing, such as decimation, expansion, theory and design of multirate filter banks, wavelet transform, and applications of multirate signal processing. (Prerequisite: EE432)

EE734 Image Understanding
This course explores the theory and methodologies used to interpret images and videos in terms of semantic content. Techniques from pattern recognition are introduced and discussed to explain how to apply them for image understanding. (Prerequisite: EE535)

EE735 Computer Vision
This course will explore the principles, models and applications of computer vision. The course consists of five parts: image formation and image models; generic features, such as edges and corners, from images; the multiple view analysis to recover three dimensional structure from images; segmentation of images and tracking; the object recognition methodologies. (Prerequisite: EE535)

EE737 Medical Imaging Technology
This course is designed to introduce several medical image systems and the related applications based on various image processing techniques. Topics include image reconstruction algorithms, X-ray CT, single photon emission CT, positron emission tomography, magnetic resonance imaging, ultrasound imaging, and related post processing techniques.

EE738 Speech Recognition Systems
The goal of this course is to provide the theoretical and technical basis required to design and implement speech recognition algorithms or systems. The topics include acoustic-phonetic characterization, speech processing techniques for speech recognition, pattern comparison techniques, theory and implementation of HMMs, searching techniques for continuous speech recognition, and other related implementation issues. (Prerequisite: EE432)

EE739 Cognitive Information Processing
This course discusses cognitive information processing mechanism in our brain and computational models for human-like cognitive systems. We will first discuss neural data representation, and move to the models of perception, attention, socialization, memory, learning, reasoning, and problem solving.

EE742 Ray Analysis for Electromagnetic Scattering Problems
This course is designed for introducing ray analysis to analyze electromagnetic scattering problems. As one of the ray analyses, GTD (Geometrical Theory of Diffraction) is explained and employed to solve various electromagnetic scattering problems.

EE745 EMI / EMC Design and Analysis
This course is designed to provide fundamental principles of EMI / EMC with numerous design practices of high performance circuit, module, and system to meet EMI / EMC compliant specifications. (Prerequisite: EE204, EE304)

EE746 Radar Systems
This course cover many facets of the topic of high resolution radar, including basic principles, radar systems, Doppler radar, polarimetric radar, and spaceborne radar, and Synthetic Aperture Radar.

EE748 High-Frequency Passive Devices
Course objective is to provide a comprehensive understanding of various high-frequency passive devices and their circuit characteristics for RF/MW systems & applications.

EE755 Advanced Coding Theory
This is an advanced course on coding theory, which is a sequel to EE621. We continue with more in-depth treatment of LDPC and turbo codes followed by some recent developments in coding theory including rateless codes and dirty paper coding. Topics covered are: codes on graphs, message-passing, irregular LDPC code ensembles, density evolution, concentration theorem, stability condition, thresholds, capacity-achieving sequences for BEC, EXIT chart, EXIT function and area theorem, multi-edge type LDPC codes, LDGM, rateless, LT, and Raptor codes, efficient encoding for LDPC codes, Code design in Euclidean space, coding and shaping gains, lattice strategies for coding, dirty paper coding

EE756 Advanced Information Theory
This course covers advanced topics in information theory, especially, multiuser information theory and network information theory.

EE757 Nonlinear Fiber Optics
This course is designed to lecture nonlinear optical phenomena in optical fiber and their applications including effects on optical communications. The course will start with general concepts of nonlinear optics and wave propagation in optical fiber.

EE758 Optical Networks
This course provides a broad introduction to optical networks. We review the fundamentals of optical communication technologies, the optical circuit and packet network technologies, and all optical packet switching networking. Topics include optical fiber system, optical networking technologies, PON, WDM networking, IP over WDM, OPS/OBS, and optical layer management technologies. (Prerequisite: EE441, EE520, EE527)

EE762 Advanced MOS Device Physics
This course will cover advanced device physics of MOSFETs and their ultimate scaling. Recent trends such as a new device structure and a new material will be introduced, and various types of memory devices as an example of detailed applications are also covered. Through a depth of study in quantum effects, reliability issues, and modeling, this course can provide core knowledge of next device technologies and a chance to explore new applications. (Prerequisite: EE362, EE561)

EE764 Quantum Engineering for Nanoelectronic Devices
In this course, basic principles, applications, and recent issues in front-edge nanoelectronic devices such as RTD, FinFETs, nanowire MOSFETs, Carbon nanotubes, Graphene nano-ribbons, quantum dot, and spin-based devices will be covered. This course consists of theoretical consideration of the subjects and practical on-line simulation sessions using existing tools. (Prerequisite: EE565)

EE766 Plasma Electronics
In this course, the basic concept and principle of plasma electronics will be studied. In particular, the basic phenomena of electronics in gas phase and the fundamental theory of plasmonics will be studied. The application of plasma electronics for plasma process and high efficiency electronic displays and energy devices will be also discussed.

EE768 Flexible Electronics

In this course, a new technology trend in electronics, flexible electronics, will be discussed and studied. The fundamental concept of flexible devices and materials including fabrication process will be introduced, and the applications of flexible electronics to TFTs, Display, Solar cell, and Sensors are also discussed.

EE772 Electronic Circuits for Green Energy
This course will teach students fundamental concepts and technologies for energy harvesting systems and their related circuits, as well as power management IC technologies that can minimize the power usage.

EE773 Bio-Medical CMOS IC Design
This course covers broad aspects of electrical engineering including fundamental concepts, history, and various application areas. Roles and futures of electrical engineering are also addressed in this course.

EE783 Adaptive Control Theory
This course deals with system identification to know the unknown system parameters for controlling the system. There are two schemes for the control of the unknown system: one is direct adaptive control and the other is indirect adaptive control. Robust adaptive control and adaptive control for nonlinear systems are dealt with. (Prerequisite: EE581)

EE785 Robust Control System
This course introduces variable structure control (VSC) theory which is one of the robust control theories. By integrating multi-variable structure with optimal control theory and adaptive control theory, the problem of system optimization and the problem of determining coefficients of switching vector in sliding mode will be resolved. Based on those theories, discrete variable structure control (DVSC) will be introduced. Finally, it will be studied how to apply those theories to the control system in robot systems, space aerial planes, satellites, chemical plants, power plants and motors. (Prerequisite: EE581, EE681)

EE788 Robot Cognition and Planning
This course deals with sensor fusion, decision making and information procession on real time for intelligent robots. To have a higher level of cognition, advanced level of problem solving methods are presented for task planning, scheduling and navigation planning. Prerequisite: EE682, EE683)

EE790 Memory and Soc TechnologyPower Conversion Circuits and Systems
This course covers the practical design and analysis of various DC / DC converters in the power conversion system. High frequency transformer, inductor, Magnetic Amplifier, Snubber, and Feedback Stabilization is studied to give students deep insight of power conversion system. Also the power factor correction circuit is introduced as AC / DC converter. Every student carry out the term project about design and modeling of a DC / DC converter. On completion of this course, students will have confidence on their ability of design and analysis of power conversion system.

EE791 Power Conversion Circuits and Systems
This course covers the practical design and analysis of various DC / DC converters in the power conversion system. High frequency transformer, inductor, Magnetic Amplifier, Snubber, and Feedback Stabilization is studied to give students deep insight of power conversion system. Also the power factor correction circuit is introduced as AC / DC converter. Every student carry out the term project about design and modeling of a DC / DC converter. On completion of this course, students will have confidence on their ability of design and analysis of power conversion system.
(Prerequisites: EE391, EE594)

EE793 Systems and Applications of Artificial Intelligence and Machine Learning

This course covers fundamentals of p-n junction and MOSFET. Afterwards, Device structure, operational principle, design technology for DRAM, SRAM, Flash memory will be covered in depth. Beyond future device and design with architecture for next generation memory, logic device and design technology for system LSI will be introduced by KAIST faculty and Samsung engineers.

EE807 Special Topics in Electrical Engineering

EE808 Special Topics in Electronic Engineering I

EE809 Special Topics in Electronic Engineering II
This course covers topics of interest in electrical engineering at the graduate level. The course content is specifically designed by the instructor.

EE817 Special Topics in Computer Engineering
This course covers topics of interest in computer engineering to students at the graduate level. The contents of this course are specifically designed by the instructor.

EE827 Special Topics in Communication
This course covers topics of interest in communication engineering at the graduate level. Course content is specifically designed by the instructor.

EE837 Special Topics in Signal Processing
This course is to introduce some important topics in the general area of communications and signal processing. Topics may vary from year to year.

EE838 Special Topics in Image Engineering
This course introduces a selected topics of recent technologies and algorithm related to image processing and imaging systems. (Prerequisite: EE432, EE535)

EE847 Special Topics in Electromagnetics
This course is designed to cover the special topics of current interests in electromagnetics.

EE857 Special Topics in Optical Engineering
This course is designed to cover the special topics of current interests in optical engineering.

EE867 Special Topics in Physical Electronics
This course covers topics of interest in physical electronics at the graduate level students. The course content is specifically designed by the instructor.

EE868 Special Topics in Solid-State Physics
This course covers topics of interest in solid-state physics for students at the graduate level. The content is specifically designed by the instructor.

EE877 Special Topics in Integrated Circuits
This course covers topics of interest in integrated circuits for students at the graduate level. The course content is specifically designed by the instructor.

EE878 Special Topics in VLSI
This course covers recent issues related with the VLSI System design.

EE887 Special Topics in Robotics
This course covers topics of interest in robotics for graduate level students. Course content is specifically designed by the instructor.

EE888 Special Topics in Control Theory
This course covers topics of interest in control theory at the graduate level. Course content is specifically designed by the instructor.

EE897 Special Topics in Power Electronics
This course covers topics of interest in power electronics for students at the graduate level. Course content is specifically designed by the instructor.

EE898 Special Topics in Intelligent Information Processing
The relationship between intelligence and information is explained. New realization techniques of intelligent systems are illustrated. Design methods of intelligent systems are explained with relation to information flow.

EE960 M.S. Thesis Research
In this course, the student selects an advisor and a research topic, and conduct research for basic understanding and application of a specific topic in electrical engineering.

EE965 M.S. Individusl Study
A research course for non-thesis Master's degree program student. Research subject can be selected with a professor who is going to guide research during the semester.

EE966 M.S. Seminar
This course is composed of invited lectures given by experts in electrical engineering and various related subject areas.

EE969 M.S. Thesis Seminar
This is the same course as EE989 Ph.D. Thesis Seninar but to be taken by M.S. students. In this seminar, Ph.D. candidates give talks on their research in the semester they do thesis defense. M.S. students taking this course can learn about various research topics performed in the department.

EE980 Ph.D Thesis Research
In this course, the student selects an advisor and a research topic, and conducts research for basic understanding and application of a specific topic in electrical engineering.

EE986 Ph.D Seminar
This course is composed of invited lectures from experts in electrical engineering and various areas.

EE989 Ph.D. Thesis Seminar
This is the same course as EE969 M.S. Thesis Seninar but to be taken by Ph.D. students. In this seminar, Ph.D. candidates give talks on their research in the semester they do thesis defense. Ph.D. students taking this course can learn about various research topics performed in the department.

EE998 Internship Program and Research (M.S.)
This course provides students with opportunity for industry experience for their advancement toward industry career. Students will conduct research activities, for 8 hours a week during spring and fall semesters (16 hours a week during summer and winter semesters), at the premise of the hosting company or institute that pursues industrialization of technologies (fulfilling ITRC Co-Op requirement). The advisor has to provide an arrangement with the hosting company or institute beforehand about the research topic at an advanced level of research toward industrialization. 3 academic credits are conferred.

EE999 Internship Program and Research (Ph.D.)
This course provides students with opportunity for industry experience for their advancement toward industry career. Students will conduct research activities, for 8 hours a week during spring and fall semesters (16 hours a week during summer and winter semesters), at the premise of the hosting company or institute that pursues industrialization of technologies (fulfilling ITRC Co-Op requirement). The advisor has to provide an arrangement with the hosting company or institute beforehand about the research topic at an advanced level of research toward industrialization. 3 academic credits are conferred.