

Descriptions of Courses

□ Graduate

ICE502 Computer Architecture

Covers modern computer architecture, focused on instruction set design, pipelining (hazards, instruction-level parallelism, branch prediction) and memory hierarchy (cache, main memory, virtual memory). System issues such as storage systems (I/O device, I/O performance, RAID, File system) and parallel computer architectures are also studied.

ICE503 Operating System

This course is concerned with the principles and practice of modern operating systems. We will study core operating system principles: processes and threads, kernel design and protection, concurrency and synchronization, memory management, disk and I/O systems, networking and distributed systems, and possibly security. The course goals are to give you a strong foundation in the key concepts of operating systems and to help your understandings on current hot topics with respect to modern operating systems, such as real-time operating systems, multimedia operating systems, system-level quality-of-service provisioning as well as middle-ware support for soft-real time applications. You will work in groups of 2 or 3 for writing a term (survey) paper. You will present your term papers in presentation sessions with myself. If time permits, we will use an instructional operating system, such as Nachos, for hands-on exposure to operating system design and implementation issues. In that case, a strong C/C++ Unix background

ICE504 Probability & Random process

This course covers not only the basic theoretical concepts but also how to solve problems in engineering and management practices. This course requires that the students develop problem-solving skills and understand how to make transition from a real problem to a probability model for that problem.

ICE505 Digital Signal Processing

In this course, the basic ideas of digital signal processing techniques are covered. The techniques to be dealt with in this course include the sampling theory, the Z-transform, the Fourier transform, the analog-to-digital filter design techniques, the digital filter design techniques, spectral analysis, and cepstral analysis. Homework will include problem solving, programming, and the summary of a related research paper. Students who are willing to major in multimedia, digital and mobile communication, and coding algorithms are strongly encouraged to take this course as a base for their future research.

ICE506 Digital Communication Theory

Basic concepts for transmitting digital information over the channel will be covered: Source Coding/Decoding, Modulation/Detection, and Channel Coding/Decoding under noisy environments. Principles of signal theory will be adopted in representing modulation signals. Various modulation techniques for power-efficient and bandwidth efficient schemes are covered. Optimal detection/estimation techniques are introduced in theory as well as in implementation. Coding schemes such as block, convolutional, and TCM are also treated in this subject. Term project on the topics covered and will be presented by the student in class.

(Prerequisites : ICE504, ICE513)

ICE507 Telecommunication Network Engineering

The lecture on communications network engineering will introduce the key technologies in the communications network and will cover a wide variety of problems encountered in designing communications network and presents common techniques to solve them. The lecture will handle the problems that must be solved during the design of communications network and introduce the basic principles, the theoretical models for networking, and the network capabilities to be needed for the high-speed network services as well. Especially, internetworking and high performance networking also will be handled in the lecture.

ICE508 Numerical Methods for Engineers

This course is presenting broad overview of numerical methods for students who need to apply computer solutions in many practical applications.

There are many existing application packages available for students to learn just how to use it, and to apply to

real problems without basic numerical knowledge. No wonder why one cannot explain about the validity of the results, as well one feels difficulty to try new strange problem for which the existing package cannot handle. With proper understanding of basic numerical procedure, one can enhance one's usage of computers and will be prepared for the new challenging problems.

The course will cover some important numerical aspects of linear equations, nonlinear equations, interpolation, numerical integration, ordinary differential equations, and some of eigensystems.

This course is recommended for both upper undergraduates and graduate students.

ICE509 Electromagnetic Fields and Wave Propagation

This course will try to give clear understanding of Electromagnetic Wave Properties which forms the backbone of modern radio communications. It is dealing with Maxwell equation, boundary value problems, Green's function, waveguides and propagation of radio waves. Some modern computational method to solve the field problems are introduced in along with conventional analytic methods. Applications like mobile communication system, optical communications, antenna design or RF/Microwave circuits will be discussed to help the practicing engineers to gain physical insights. Prerequisite for this course is college level electromagnetic courses, and advanced mathematics.

ICE510 Semiconductor Device Physics

This course provides a fundamental understanding of the semiconductor device physics, operation principles and device characteristics associated with modern microelectronic devices. In particular, fundamental concepts such as the energy-band, carrier distribution, transport properties, basic device technology and p-n junction characteristics are covered. Besides, the important electronic structures and theories associated with bipolar transistors and MOS transistors are also discussed.

ICE512 Wave Optics

This course provides physical principles and applications of modern optics for research in optical communication, optical signal processing and optical devices. The contents of this lecture cover geometrical optics, wave optics, propagation through media, wave-matter interactions, Fourier optics, electro-optics, acousto-optics, nonlinear optics and quantum optics. Basic principles, practical systems and applications are emphasized to understand the optical communication systems and devices.

ICE513 Linear systems

This class is one of the basic courses to study Signal Processing, Coding and Information Theory, Modulation Theory, Communications Theory, Communications Engineering, Signal Detection and Estimation Theory.

ICE519 Coding Theory

After introducing basic information theory such as entropy theory, mutual information, channel capacity, noisy coding theorem, noiseless coding theorem, this courses introduces basic concepts on coding theory and several famous codes such as block codes, Reed-Muller codes, BCH codes, Reed-Solomon codes, and Golay codes. Basic concepts includes encoding, decoding, syndrome, generating matrix, error detection and correction, probability of error, minimum distance, covering radius, weight enumerator, linear codes, cyclic codes, dual codes, self-dual codes, and perfect codes. This course mainly focuses on cryptographic aspects and usage of the coding theory.(Prerequisite : ICE518)

ICE528 Digital Switching Engineering

This course covers various switching technologies for telecommunication networks such as circuit switching, packet switching, frame relay, ATM, and IP routing technologies in terms of basic concepts, underlying technologies, protocols, and fundamental components and functions of switching systems. It also deals with traffic theory, network architectures as well as implementation examples for switching systems.

ICE531 Wireless Communication Soc I

This course covers the analysis and implementation of a specific wireless communication system. This well-equipped laboratory focuses on the implementation and demonstration of the whole wireless system including source coding, baseband, and RF transceiver. The target system has the OFDM technology, MIMO technology, channel coding, etc. The implementation of the system is processed using pre-implemented IPs and newly designed IPs through the concept of SoC.

ICE534 Web-based Software Development

The World Wide Web (Web) is now considered as a global software engineering environment for collaboratively developing large-scale software systems, and a medium for economically deploying software components and remotely accessing various component services. The main goals of this course are to gain knowledge about various Web-related technologies and software engineering concepts that enable efficient development of large, complex Web-based software, and to practice them by performing a term project. The state-of-the-art technologies, including Internet agents, Web Services, Semantic Web, service-oriented architectures, and service coordination mechanisms, are covered in this course.

ICE539 Software Engineering Economics & Management

As software size is getting bigger and more complex, it is very hard to lead software projects successful. During the course of software development, project managers need to solve various problems related to people, economic values, and software techniques. The primary objectives of this course are to enable the students to understand the fundamental principles underlying software management and economics; to analyze management situations via case studies; to analyze software cost/schedule tradeoff issues via software cost estimation tools and microeconomic techniques; and to apply the principles and techniques to practical situations.

ICE540 Bioinformatics

This is an introductory course of bioinformatics. The general objective of the course is to provide a one semester introduction and overview to the fields of bioinformatics and genomics. This includes practical knowledge in biology general, genomics, functional genomics, proteomics, structural genomics, and various algorithms and computational tools in bioinformatics fields.

ICE541 Biochemistry

Biochemistry is the study of the molecular basis of life. This course includes the principles of biomolecules and molecular processes that are fundamental for the functioning and maintenance of cell, tissues and organs.

ICE542 Molecular Genetics

This course provides integrated molecular and classical genetics. The topics have been chosen to help students achieve the following objectives:

- Understand the basic processes of gene transmission, mutation, expression, and regulation.
- Learn to formulate genetic hypothesis, work out their consequences, and test the results against observed data.

ICE543 Experimental Methods in Biotechnology and Lab.

As a Bioinformatics track core course, students will learn the experimental techniques used in Biotechnology relevant to Bioinformatics. The emphasis is on DNA and protein sequencing methods and gene expression analysis to learn how biological data could be obtained by high throughput experiments. There will be also an introduction to protein structure & function analysis, and analysis techniques for cellular biomolecules such as immunohistochemistry and in situ hybridization. For students who do not have a strong biological background, the course shall provide enough knowledge and hands-on experience to understand experimental methods used in Bioinformatics and Biotechnology. Laboratory classes will be carried out at Korea Basic Science Institutes (KBSI) and Korea Research Institutes of Biology and Biotechnology (KRIBB) under the supervision of Drs. Seung Il Kim (KBSI) and Young Il Eom (KRIBB).

ICE545 Data & Text Mining

This course will introduce the essential techniques of text mining, understood as the process of deriving high-quality information from unstructured text. The techniques include: the process of analyzing and structuring the input text with natural language processing methods, deriving patterns with machine learning methods, and evaluating and interpreting the output. The course will cover some typical text mining tasks such as text categorization, text clustering, document summarization, and relation discovery between entities.

ICE546 Embedded Processor Design

This course studies fundamentals of designing embedded systems. The following topics will be covered in the course:

- Review of combinational and sequential logics
- Datapath components such as adders, shifters, counters, etc
- Introduction to VHDL

- Custom single-purpose processor design
- General-purpose processor design
- Application-specific processor design
- Commercial processors-ARM processor, Intel 8051 microcontroller, DSP processor
- Peripherals
- Memory
- Interfacing
- Example- digital camera
- Concurrent process models
- Example- Wireless sensor node
- Power/Reliability issues

Throughout the course, students will be asked to apply their understanding of the above topics on homework assignments and tests. We will use VHDL to implement simple single-purpose and general-purpose processors.

ICE552 Computer Science for Engineers

This course offers various background topics for software engineers to start graduate level study of software engineering study. Topics include

- Advanced Discrete Mathematics
- UML and Design Tool
- Probability Model
- Advanced Data Structure and Algorithm
- Object-oriented Systems & Middleware

After successful completion, students will be ready to various graduate level software engineering courses such as models of software systems, analysis of software artifacts, methods of software development and software architecture. The official programming language of the course is Java.

ICE565 Introduction to acoustics

ICE573 Next Generation Display Engineering

ICE574 Introduction to Quantum Electronics

Quantum mechanics and electronics are at the heart of modern science and engineering. In engineering, especially in the fields of semiconductors, optics, and electronic devices, all the fundamental theories originate from the quantum mechanics. Therefore, for advanced and creative research, quantum mechanics is a must-to-be-learned subject for engineering majors. This course aims at providing the basic quantum mechanics concepts and problem-solving skills in applications to electronic devices to undergrad seniors and first-year graduate students. In this course, the basics of quantum mechanics will be first discussed, and then the Schrodinger equation which is considered as the master equation in quantum mechanics will be introduced. The problems in modern electronic and optoelectronic devices will be then formulated in the framework of the quantum mechanics and their solution will be sought through the solution of the Schrodinger equations.

ICE577 Numerical Linear Algebra

Linear algebra is one of the most fundamental subjects needed in engineering. The basic question in linear algebra is how to solve various systems of linear systems. First, in this course, we introduce the notion of matrix and operations of matrices. Some notion such as Gaussian elimination, orthogonality, eigenvalues, and eigenvectors will also be introduced. These are beyond the high school math scope, but can be learned and understood using basic matrix algebra rather than abstract theorem or proof.

ICE578 Estimation Theory

In this course, students can learn theories of optimal estimation and how to design optimal estimation algorithms that may be implemented on a digital computer. The necessary background that has been assumed is an exposure to the basic theory of digital signal processing, probability and random processes, and linear and matrix algebra. The prerequisites are believed to be elementary topics in undergraduate schools of electrical engineering and other related departments. Senior undergraduate students and graduate students in good standing can take this course without any difficulties.

ICE579 Geographic Information Systems

ICE580 Multimedia Communication Middleware

Communication middleware is a distributed software layer that sits above the network operating system and below the application layer and abstracts the heterogeneity of the underlying environment. The role of middleware in communications 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 on communication middleware will introduce basic principles, architectures, and interactions specifically in Java environments, and regarding computing architecture and middleware in future Grid computing infrastructure.

ICE581 Introduction to SoC

This course is to define SOC design and present the basics of SOC design methodologies. Topics to be covered include: specification & modeling, communication-based design, and the validation & performance analysis of embedded systems.

ICE582 CMOS VLSI Design

ICE584 Introduction to Biomedical Engineering

This course will introduce fundamental medical technology based on electrical engineering disciplines. Topics include anatomy and physiology related to important human diseases and biomedical engineering principles focusing on instrumentation, sensors, imaging, and ubiquitous healthcare services.

ICE585 Introduction to Software Product Line Engineering

ICE600 Computer Networks

This course covers key computer network technologies and especially current issues facing modern computer networks. Network architecture (hardware and software), internetworking using TCP/IP, routing, congestion control and quality of service, ATM networks, high-level network services and Next Generation Internet are major items. Performance modeling and estimation of computer networks also are covered throughout this course.

ICE601 Distributed Systems

This course provides theoretical knowledge and hands-on experience with distributed systems' design and implementation. The course will focus on the principles underlying modern distributed systems such as networking, naming, security, distributed synchronization, concurrency, fault tolerance, etc. along with case studies. Emphasis will be on evaluating and critiquing approaches and ideas.

ICE602 Ubiquitous Networking

ICE605 Modern Cryptography

With the advancement of information infrastructure, the side-effects such as illegal wiretapping, modification, or insertion, etc of information are rapidly increased. This course focuses the student to be capable of designing the theoretical and practical countermeasures against such malicious acts for building secure information society. This course deals with symmetric cryptosystem (conventional cryptosystems, block and stream ciphers), asymmetric cryptosystem (RSA, Diffie-Hellman, etc), digital signature, hash function, identification, zero-knowledge proof, and the latest hot issues by student term projects.(Prerequisite : ICE518)

ICE606 Database Systems

The objective of this course is to give students not only the understanding of rapidly advancing database management techniques but also the capability of applying them to various applications and services, such as e-Commerce, digital library, and Internet-based information systems. The course will cover different approaches to information modeling, languages, query processing, optimization, and data storage and manipulation techniques. Students will experience a real-world design and implementation of class-level information management systems through the term projects.

ICE608 Artificial Intelligence

Knowledge representation, heuristic search, machine learning, problem solving, and logic deduction are introduced. Based on these concepts, students learn how to build the artificial intelligence application systems such as natural language processing, computer vision, intelligent search systems, expert systems.

ICE609 Computer Graphics

This course aims at providing a broad introduction to the field of Computer Graphics. Topics include geometric objects and transformation, viewing, shading, rendering, modeling, texture mapping, animation and visualization. Through a series of programming assignments, students will become familiar with interactive 2D and 3D graphical display concepts.

ICE614 Natural Language Processing

This course provides an introduction to the field of Natural Language Processing (NLP) - the creation of computer programs that can understand, generate, and learn natural language. Three major subfields of NLP, syntax, semantics, and pragmatics, are introduced together with morphology. The course will introduce both knowledge-based and statistical methods for NLP, and will illustrate the use of such methods in a variety of application areas such as text mining, information extraction, and conversational agents.

ICE615 Network Security

This course offers how to evaluate a variety of vulnerabilities over the existing network and how to construct security protocols and their applications by using cryptoalgorithms, digital signature and hash function to guarantee integrity of information and authentication of network entities. Moreover, every student can get the knowledge on a typical network authentication protocol like Kerberos, secure e-mailing system like PEM, X.400, S/MIME and PGP, emerging network security protocol like IPSEC and SET protocol and firewall.(Prerequisite : ICE605)

ICE617 Human Computer Interaction

Human-Computer Interaction is a study of efficient communication between people and computers, and the communication usually is via multiple perceptual channels. An important implication of this definition is that HCI is a highly interdisciplinary study that requires understanding of different subjects from diverse disciplines such as psychology, psychophysics, graphics, and software engineering, to name a few. Therefore, the course will be a collection of reference points where students can start their own investigation into subjects in HCI. The course will start with the most basic topics in HCI, such as usability principles, capabilities and constraints of perception and expression processes, in both human and computer perspectives, models of interaction, and prototyping and evaluation techniques. The latter part of the course will deal with special topics, such as interfaces for small computers, virtual reality input/output devices, brain-computer interfaces.

ICE619 Advanced Digital Communication Theory

In this course, we explore basic concepts of detection and estimation theory and their application to digital communications such as optimum detection rule on AWGN and synchronization. Then, we study the theory of efficient digital communication over linear dispersive channels, including adaptive equalization.

ICE623 Data Communications

It studies the computer network architecture based on the OSI 7 layer model. It explains the layer protocol including TCP/IP protocol in detail. The practical experiences of TCP/IP programming are included using the SDL (Specification and Description Language) and socket programming. In addition, the recent trends of Internet protocols are also lectured such as IPv6 and Mobile IP.

ICE625 Telecommunications 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. Basically lecture will handle the TMN that should be considered in telecommunications network and introduce the basic principles of OSI-based management. And a newer paradigm for managing networks is also treated in the lecture, one that provides a better network-wide view than the legacy approaches. New technology trends will add more intelligence to network management, relieving network managers and how the network is meeting business needs, e.g. policy based networking. By shifting the emphasis of the network management away from devices and interfaces to users and applications, abstracting the details of device configuration, and centralizing the creation and storage of network policies, the policy based networking offers a solution to many of the pressing network management problems.

ICE626 Digital Image Processing

This lecture provides basic concept of digital image processing and visual information. Students will learn various techniques for the image processing, which could be applied to multimedia processing in the Internet, digital broadcasting and video telephony. Students are required to practice the technique learned in the lecture through some experiments including computer simulations. This is very helpful to learn the core of the lecture. The practices include the development of algorithms or demonstration of tasks using image processing tool such as Matlab. General topics which will cover in the lecture are as follows :

- Human Visual Perception, Sampling and quantization
- Image Enhancement and restoration
- Image transformation and Compression
- Image segmentation and understanding

ICE629 Speech and Audio Coding Theory

The purpose of this course work is to learn the mathematical background and implementation techniques of classical waveform coding methods such as PCM and ADPCM and recent mobile coding methods including MPLPC, CELP, IMBE, so on. Also, we study the audio coding techniques. It includes Sampling & Quantization, LPC modeling and LSF quantization, AbS coding, Low-Delay coding, System Application, etc.

ICE630 Video Coding Theory

Recently video compression becomes reality in digital television and telecommunications areas as well as in multimedia area. The video coding theory class aims at providing students with the comprehensive overview of the principles and algorithms employed in still image and video compression technologies. A particular course objective is an in-depth understanding of the rationale behind the frame-based video coding such as MPEG-2 video coding standard and the object based video coding such as MPEG-4 visual coding standards as well as their related systems issues.

ICE631 Pattern Recognition Theory

The course objective aims at learning pattern recognition theory. The course covers a wide range of pattern recognition techniques in the areas of statistical, neural and syntactic pattern recognitions. The pattern recognition plays an important role in the areas of finger print identification, speech recognition, image understanding, characteristic recognition, target detection/recognition and audio-visual feature extraction and indexing, etc. The major topics include design of parametric and non-parametric classifiers with supervised and unsupervised methods, neural networks for pattern recognition and grammar based approaches to syntactic patterns such as natural languages. Students also experience implementations and simulations of various pattern recognition technologies via the class homework in 4~5 times and a term project assignments.

ICE632 Speech Signal Processing

This course provides DSP-based approaches for solving the problems related to speech signal processing. We deal with speech-specific characteristics, speech analysis and modeling in time and frequency domain, homomorphic processing of speech signal, LPC modeling, and so on. Thus you can get the mathematical basis required to research the speech processing technology and develop the application systems such as speech coding, speech synthesis, and speech recognition.

ICE633 Digital Video Processing

This lecture provides basic concepts of digital video which is becoming popular in the area of Internet and multimedia communication. Topics include digital video formats for Internet and communication, compression, 2-D/3-D motion estimation, frame rate conversion, deinterlacing, MPEG and video enhancement. In addition to the theory, students require to participate in experiments that are related to the above topics. The experiments will be performed by algorithm implementation using C++ or Matlab.

ICE634 Adaptive Signal Processing

Adaptive filters such as LMS algorithm, Kalman Filter, Wiener Filter, RLS adaptive lattice filter will be studied first. And then, active noise cancellation and echo cancellation algorithms will be implemented as a term project.

ICE635 CDMA-based Communication Systems

Basic principles and the operational concepts of spread spectrum communication systems will be covered. How to make the spectrum spread for use and its properties will be introduced. Multiple access schemes, codes, code

acquisition/tracking methods, DS(direct sequence) and FH/TH(frequency/time hopping) systems are dealt comprehensively. Also, the reasoning behind the narrow-band spreading for IS-95A and wideband spreading for IMT-2000 will be introduced.

ICE636 Mobile Communication Systems

In this course, we study the fundamental and advanced topics in wireless and mobile communications systems. Topics include: (1) propagation phenomena, (2) wireless/mobile channel modeling, (3) performance evaluation of modulation schemes on multi-path fading channel, (4) techniques to combat multi-path fading such as multi-carrier modulation, adaptive equalization, and diversity, and (5) multiple access techniques, multi-user detection, and multiple-input and multiple-output (MIMO) signal processing.

ICE638 Optical Communications

This lecture course provides principles and theory of optical communications. The lecture topics will cover principles of light propagation and transmission characteristics of optical fiber, basic theory and characteristics of light sources and photodetectors. It will also cover the basic design principle of digital and analog optical communication systems. Finally advanced optical communication techniques such as WDM, soliton, and optical amplifiers will be discussed.

ICE643 Optical Circuit and System Design

Modern optical networks use advanced all-optical transmission technologies. This class teaches optical layer designing rules in a concept of circuit performances and integrated system efficiency.

ICE647 RF IC Design

Study the RF integrated circuit focusing the analysis and practical design techniques. The frequency range of interest will be 10 MHz ~ 10 GHz covering most of the commercial wireless communication systems such as cellular, PCS, GPS, WCDMA, WLAN, Bluetooth, ZigBee, UWB, etc. Topics include brief overview of active and passive RF device design/modeling, and the transistor level circuit designs — low noise amplifiers, up- & down-conversion mixers, and voltage controlled oscillators. Considering the latest technology trends, the low power and ultra wide band aspect of the RFIC design will be discussed as well as the direct conversion receiver issues. State-of-the-art examples of the reported designs will be analyzed emphasizing the silicon technologies, especially the CMOS. Circuit design project (LNA, mixer, and oscillator) using Cadence Spectre (commercial software) will be given for the hands-on experience.

ICE649 Microwave Engineering

The goal of this course is to introduce students to the concepts and principles of the advanced microwave engineering, including the use of computer aided design(CAD) methods. RF/microwave CAD is employed extensively in industry and a knowledge of the principles and methods used is important for anyone who may work in an RF/microwave related field. Theory and design of passive and active microwave components, and microwave circuits including: microstrip line, guided wave device, filter, amplifier, oscillators, and experimental characterization of above components using the network analyzer, spectrum analyzer, power and noise meters. In this course, the theoretical and practical concept of microwave engineering is useful applications to the analysis and design of microwave components, microwave circuits, and optics. The general flow of this class is Application --> System --> Component; individual components are analyzed by Fields --> Modes --> Equivalent Network.

ICE651 MMIC Design

Signal and large-signal models, noise parameters, and load-pull data, the students will design the stability and input and output impedances of the microwave integrated circuits for noise, gain, and output power. The course will cover the 2-ports network, scattering parameters, Smith charts, signal flow graphs, power gains, LNA, broadband amplifier design, power amplifier design, and simulation and analysis. The student will be assigned with term project designing a specific microwave circuit using an ICU-owned CAD tool, and the results will be implemented using an MMIC foundry. This course is designed to provide graduate students with design capability of the microwave integrated circuits such as low noise amplifiers, broadband amplifiers, and power amplifiers. By analysing the scattering matrix, small-(Prerequisites : ICE509, ICE647)

ICE653 Computer Haptics

The word 'haptic' refers to 'the sense of touch. Computer haptics is the growing discipline that deals with computation of touch sensation by allowing a user to intuitively interact with the virtual world as if the virtual world is tangible. This course covers fundamentals and design for haptic device and current state-of-the-art haptic rendering algorithms, Applications of haptic rendering will be also investigated. Students are expected to present a technical paper or book chapters in class for discussion, and learn haptics programming for application development.

ICE657 VLSI Design

Today's system integration trend is SoC (System-on-Chip) which integrates an information and communication system on a chip. SoC is composed of every kinds of IPs (Intellectual Properties), starting from CPU, DSP, memory up to communication interface, video decoders and peripherals. The requirement of short TTM (Time-To-Market) obliges us to reuse IPs. Accordingly, VLSI Design is to study the generation and integration of IPs and their reuse related issues. Generation and integration of IPs focus on the optimization of algorithm implementation, efficient design methodology and verification. Reuse related issues cover virtual component concept and coding guidelines.

ICE661 Queueing Theory

At the first half of the course we deal with fundamental stochastic processes such as Poisson process, renewal process, discrete-time Markov chain, and continuous-time Markov chain which are necessary to analyze performances of next generation networks. We then study concepts, underlying theories, and applications of IBP, IPP, MMBP, MMPP, QBD, self-similar process which are widely used for traffic modeling in high-speed data networks. We also cover basic queueing theories related to various stochastic processes.

ICE664 Optical Networks

This course converges conventional optical transmission technology into the networking area including Internet. Therefore, after covering transmission aspects of second generation fiber optic networks, this lecture focuses on the networking aspects such as architectures, wavelength routing networks, virtual topology design, deployment consideration, optical Internet, and photonic packet switching at optical layer.

ICE667 Microwave Devices

This course is designed to provide a cohesive overview of the fundamental subjects required for the design and analysis of the RF stages of modern wireless systems, including antenna, propagation, fading, noise, receiver design, modulation methods, and bit error rates. Content is also included on the design of key components used in wireless systems, such as filters, antennas, and mixers. The students are required to participate in design, evaluation, and possibly fabrication that are related to the above topics using microwave CAD tools, measurement tools, and fabrication facilities.

ICE668 RF Devices

Course objective is to provide students with a comprehensive understanding of RF devices and related circuit characteristics particularly for RF system applications. First, several key points such as two-port networks, S-parameters, Smith chart, impedance matching are studied. Then, RF filters, diodes, and field effect transistors and their characteristics will be covered.

ICE669 Wireless Transceiver Design

In this course basic principles of RF transceivers in mobile unit for modern digital communications are covered. Overall view of baseband functions such as channel coding and digital modulation is introduced briefly. The nonlinear and noise characteristics of RF systems are studied, and the architectural characteristics and system-level characterization of the RF transceivers are also studied. RF system design requirements are analyzed from the modern wireless communications standards such as IS-98A/B and 3GPP, and system-level design on the basis of the analysis is performed.

ICE676 Analysis and Design of Antenna

This course mainly deals with general theories and applications for microwave and mobile antennas. The main topics are including an introduction to antennas, analysis and synthesis of antenna elements and arrays, linear antennas, self and mutual impedance, aperture, traveling wave, broadband, and microstrip antennas. Finally antenna measurement techniques, active antenna, and active phase array technology will be mentioned.

ICE677 Wireless Communications SoC II

The purpose of this course work is to study the basic theories of the coding and the modulation which are bases of the digital communications. Especially the coding and the modulation algorithm of the hot-issued Bluetooth system will be studied and its operation will be verified.

ICE679 Multimedia Systems

ICE681 Mixed signal circuit design

This course is concerned with data converter design aspects for integrated mixed analog/digital systems. In this course, data conversion principles of various types of ADCs and DACs will be studied. Major sources of performance limitations and their effects on performance metrics will be discussed, and performance enhancing design techniques will be investigated as well from various papers and texts. Selected subjects to be discussed in this course are; Sampling circuits and comparators, various types of ADCs (Flash, Pipeline, SAR, Folding, Time-interleaving, Oversampling), various types of DACs (R-DAC, I-DAC, C-DAC), performance limitations (circuit noise, device mismatch, nonlinearity, jitter, settling speed, switching noise)

ICE683 Wireless Communication Network

Followed by the brief introduction on the evolution of wireless communications from and to future wireless communications, RRM(radio resource management) techniques with through understanding about the physical layer will be comprehensively provided. Topics include: Characterization of wireless traffic (internet traffic), multiple access techniques, call admission control, call processing, scheduling, retransmission, diversity, hand off and cell planning. Also, state-of-the-art network issues including adhoc network and mesh networks will be given. Term projects are required including presentation inclass for discussions.

ICE689 Analogue Integrated Circuits Design

This course is devised to teach graduate level analog circuit analysis and design techniques. The course will provide a general knowledge on analog circuit analysis and design techniques, which become the basics for the various analog circuits such as conventional analog, mixed signal, RF & MMICs, and optical system related circuits. The course will briefly cover the device physics for MOS and bipolar devices. The circuit analysis and design includes single-stage amplifiers, differential amplifiers, current sources and sinks, frequency response of amplifiers, noise, feedback, operational amplifiers, stability and frequency compensation, references, switched-capacitor circuits, etc. Emphasis will be on the CMOS technologies but the bipolar circuit theory would be paralleled. Simulation projects will be assigned.

ICE690 Handset L2/L3 Software

The purpose of this course work is to cultivate the ability on the area of software in wireless communication system based on the CDMA system. This course will cover capacity of system, power control, soft handoff, call admission control, call processing and so on with which the students will gain benefits to understand how to be achieved the improvement of capacity of wireless communication system in the way of software.

ICE695 Machine Learning

The goal of the course is to introduce the key algorithms and theories of machine learning to students from various disciplines. Therefore, the focus will be on the understanding of the main concepts and building the insight into the nature of various machine-learning algorithms rather than on the mathematical foundation and rigorous derivation of learning algorithms. Topics covered include, but not restricted to, concept learning, decision tree learning, multi-layer perceptrons, radial-basis neuron networks, Bayesian networks, genetic algorithms, analytic learning, and reinforcement learning. Homework problems will be biased toward application-minded students while a few reading assignments will be prepared for those who seek mathematical foundation of the learning algorithms.

ICE696 Information Retrieval

It has become a common task to retrieve and extract necessary information from the flood of information in such forms as text, image, and video, available through a variety of computer media and networks. With the advent of Internet, the sheer amount of information has been increasing greatly, which requires automated retrieval techniques to be not only effective but also efficient.

This course covers such techniques, some of which have been evolving for the past decades and others having being around only since the introduction of the World Wide Web. The main topic areas are: analysis of text and representation of its content, storage and retrieval models, human-computer interactions, evaluation of systems and

algorithms through experiments. In addition, the course will cover more contemporary topics including information organization/presentation techniques such as categorization and summarization, distributed information retrieval, information extraction, and multimedia retrieval.

ICE698 Modeling and Simulation

This is an introductory course on simulation and modeling in graduate level. Modeling and simulation are good tools that provide deeper understanding of systems of interests. The first part will cover mathematical models such as Markov chains, queues in isolation, queueing networks. The second part will cover simulation techniques such as random number generation, and so on. Basic understanding of probability and programming skills are required. Students will be asked to pick a problem of their own interests, to formulate a problem, and to solve it.

ICE702 Statistical Signal Processing

The area of signal processing deals broadly with both signals and systems. Digital Signal Processing you studied previously generally assumes that the signals are deterministic. This course, however, is aimed to provide a statistical methodology to analyze and design signals which is inherently random. Topics include signal modeling, optimal filtering, spectrum estimation and adaptive filtering.

ICE711 Human Vision Modeling

ICE714 IPTV Network and Protocol

ICE715 Mobile Computing

Mobile computing attracts tremendous attention recently due to its promise in the next decade. Communication devices such as cellular phones and pagers are merging with portable computing devices such as PDA (Personal Digital Assistant) to provide connectivity as well as productivity on the road. Mobile networking protocols and portable device technologies have been developed for the mobile computing. This course focuses on mobile networking (routing and wireless TCP) and embedded system design (low power software, embedded interfacing and communication, and cross development environment). On the exit of this course, you will have basic concept on mobile networking and extensive experience on embedded system design. (Prerequisites : ICE600, ICE601)

ICE720 Electronic Commerce

With the wide spread of the Internet, E-commerce is becoming a crucial discipline nowadays. In this course, several E-commerce related issues such as techniques, principles, benefits, and perspectives are introduced. Then each subtopic in E-commerce is treated with the introduction of its application areas. The subtopic areas include CRM (Customer Relationship Management), SCM (Supply Chain Management), Data Mining, Agent, Workflow, ERP (Enterprise Resource Planning), Security, etc. Student has to decide one interested subtopic in the course and term projects are given in the topics. (Prerequisite : ICE605)

ICE732 Information Theory

ICE736 Design and Analysis of Broadband Networks

It studies the design and performance analysis for broadband network. It includes the queueing network theory of M/M/1, M/D/1, and M/G/1. The flow control schemes of sliding window protocol are analyzed in detail. The Markovian queueing networks are modeled with operational analysis. The polling system and random access scheme for wireline/wireless Internet are theoretically investigated. The performance of switching network and time division multiplexing system are analyzed in the combination of queueing theory and scheduling algorithm. The analytical results on the broadband network system are compared with simulation results using the OPNET simulation software.

ICE745 Optimization Techniques for Mobile Communications

Fundamental techniques to analyze the communication systems will be provided both static and dynamic optimization methods including stochastic optimization techniques and systems analysis and optimal control techniques for radio environment, most complex time-varying stochastic environment. Case studies and state-of-the-art techniques from the most recent journal articles will be treated.

ICE746 Speech Recognition System

The goal of this course is to provide the theoretical and technical basis required to design or implement speech recognition algorithms or systems. The topics included are 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 implementation issues.

ICE753 Software Requirements Engineering

This course is a graduate level advanced course on Requirements Engineering. Software requirements express the need and constraints that are placed upon a software product. It is widely acknowledged within the software community that software projects are critically vulnerable when requirements engineering is applied poorly.

In this course, key knowledge areas including requirements engineering process, requirements elicitation, requirements analysis, requirements traceability, requirements validation, requirements control, and requirements tools are covered. Then advanced topics on requirements engineering will be discussed. At the end of the semester, students should submit a term project result.

ICE754 Software Process

This course is a graduate level advanced course on software engineering. Software process is a topic of great interest to the software engineering community. A process is an important leverage point from which to address software quality and productivity issues.

The overall goals of this lecture are to understand foundations on software process, concepts of defining process, and how to apply process concepts to improve software quality and productivity. In this course, key knowledge areas including Capability Maturity Model(CMM), Capability Maturity Model Integration(CMMi), Personal Software Process(PSP), Team Software Process(TSP), Process Definition, Process Assessment, and Software Engineering Body of Knowledge(SWEBOK) are covered.

ICE763 Ubiquitous Computing System

This course is intended for graduate students. This course introduces the fundamentals of ubiquitous computing system. It focuses on the main components of a ubiquitous computing system such as location sensing, context management, service discovery, dynamic service reconfiguration, spontaneous networking, and security/privacy. These concepts will be explained by analysis of and discussion on the existing systems. Students will be asked to participate in this and to pursue a term project.

ICE764 Optimal Combining and Detection in Wireless Communications

ICE802 Special Topics on Computer Networks(Pervasive computing)

This course is intended for graduate students. This course introduces the fundamentals of pervasive computing system. It focuses on the main components of a pervasive computing system such as adaptive networks (including sensor & ad-hoc networks), context management, dynamic service reconfiguration, service discovery, and security & privacy. These concepts will be explained by analysis of and discussion on the existing systems. The students will be encouraged to participate in this and to pursue a term project using Active Surroundings, pervasive system.

ICE809 Special Topics on Artificial Intelligence

Special Topics on Artificial Intelligence (ICE0809) focuses on one or two subfields of artificial intelligence, and provides students with the opportunity to learn, discuss, and experiment with the state-of-the-art technologies. The topic areas vary semester by semester, but some of the topics covered recently include "AI and robot programming", where the aim was to let the students get hands-on experience on programming some intelligent systems in the fields of AI and Robotics. Students will generally be asked to perform many examples and projects.

ICE812 Special Topics on Advanced Networks

The objectives of this course are examining and debating the current research topics in broadband communication networks. The subject will be diverse, ranging from new theory and algorithms. With the guidance of the instructor, students are expected to understand some topical areas, find papers in the areas, study, criticize, suggest new ideas, and present in person during the class as a term project. Much learning expected through this process and group discussion in class. Reports are to be written on the basis of the study. The report must reflect coherent view and understanding of the course and well written to publish in journal. Credibility of the technical content in the report is important.

ICE814 Special Topics on Multimedia Systems

This course provides special topics about multimedia system. In this semester, MPEG-7 and its related technology, which is one of active part for the world standardization recently, will be covered. In the lecture, a basic technology for the MPEG-7 description and a prototype system (XMA) of MPEG-7 will be introduced. Student shall have many practices through term projects with the topic of multimedia indexing system.

Overall topics for this course are the following.

- MPEG-7 Overview
- MPEG-7 requirement
- MPEG-7 XM
- MPEG-7 XMA

ICE815 Special Topics on Image Engineering

This course deals with advanced topics on video coding systems. Topics covered will include: MPEG-4 visual, H.264, SVC (scalable video coding), and their implementation issues. Students are assumed to have taken ICE630: Video Coding Theory or equivalent knowledge. Students completing this course will be able to get the profound knowledge on the most advanced video coding schemes.

ICE833 Special Topics on Optical Internet

This course attempts to cover special topics on optical Internet which marries the next generation Internet and fast evolving DWDM optical network. Examples for the topics are integrated IP/WDM, MPLmS, Routing and wavelength assignment, protection and restoration, traffic engineering and planning, survivability and availability, labeled optical burst switching, optical packet switching, and optical packet Internet.(Prerequisite : ICE 664)

ICE834 Special Topics on Microwave System

The goal of this course is to introduce students to the concepts and principles of the advanced microwave system, including the use of computer aided design (CAD) methods. Theory and design of passive and active microwave components is included such as LNA, PA, mixer, PLL system, antenna and experimental characterization of above components using the network analyzer, spectrum analyzer, power and noise meters. In this course, the theoretical and practical concept of microwave system is useful applications to the analysis and design of microwave components, and microwave systems.

ICE839 Special Topics on Ad Hoc Networks (I)

Students will develop working knowledge of the research problems and applications of ad hoc networks. The course will cover the technologies for constructing ad hoc sensor networks and their applications. Students will be assigned a list of state of the art published papers along the subject. Students will present the papers and discuss with other students as to how to utilize and improve the ideas Students are required to submit progress report each week. It is recommended that students have a good working knowledge of probability and random processes, data communications and network.

ICE840 Special Topics on Ad Hoc Networks (II)

This course is continuation of ICE839 Special Topics on Ad Hoc Networks (I). This course will place emphasis on queueing theory and advanced simulation techniques for ad hoc network systems performance analysis. Students will be asked to pick own project and produce complete results.

ICE846 Special Topics on Network Convergence

Network convergence brings advantages of convenience and cost effectiveness to both users and the service providers. This class teaches the newest fixed and mobile network services and technologies, and the core convergence technologies for networks and services.

ICE847 Special Topics on Wireless Digital Processing

This course covers the digital signal processing technology requires to design digital wireless communication transceiver. Basic building blocks such as digital filter, data conversion, and sampling rate conversion are issued in this lecture. Especially, recent technologies are covered such as delta-sigma modulation, Farrow filter structure, and polar transmitter architectures.

ICE848 Special Topics on Advanced Communication Middleware and Computing system

The lecture about special topic on advanced communication middleware and computing system will introduce the key issues in the advanced communication middleware and will cover a new paradigm encountered in next generation web services and advanced applications, e.g. e-health services. Basically lecture will handle the Grid middleware that should be considered in advanced computing infrastructure and introduce the basic principles of web service architectures and operation frameworks, respectively. And a newer paradigm for advanced applications is also treated in the lecture. New technology trends will add more intelligence to communication middleware, relieving advanced web applications and how the communication middleware is meeting business needs in these areas.

ICE849 WLAN MAC System Design Lab

This course covers all MAC (Medium Access Control) techniques in IEEE 802.11 WLAN standard. All WLAN MAC standards during a decade are covered such as 802.11 legacy, 802.11e, and 802.11n. Based on these knowledges, a real SoC implementation of IEEE 802.11n MAC will be experimented in this class.

ICE851 RFID System Design Lab.

This course covers the understanding and the implementation of various kinds of recent RFID systems such as ISO14443A/B, 15693, and 18000-3 standards. The anticollision techniques in MAC layer and the modulation algorithms are compared for different standards. SW, HW, and reconfigurable implementation are studied and experimented by real implementation of Xilinx FPGA board.

ICE853 Converged Optical and Wireless Access Networks

This course attempts to witness technological challenges in converged optical and wireless networking, which is a key element for next generation broadband network. This course covers transmission aspect of fiber optical network, optical access networks, mobile access, and broadband wireless access. Then, Converged network issues are covered by topical seminars and term- project papers preparations.

ICE852 Special Topics on Future Networks

This course surveys and analyzes in depth R&D activities on future networks being carried by international standardization institutes, universities and leading projects. Analysis will cover trends in newly adopted concepts, new telecommunication services, network architectures, network components and their functions, and embedded technologies which enable visualization of future networks. This course also covers technical issues such as mobility support, E2E QoS, network security, session control, CAC, resource management, and traffic control.

ICE854 Special Topics Communications Networks

The goal of this course is to understand current research topics in ad-hoc networks. And Through this course, you can improve skills of condensing other's technical works, improving or finding further works of your own, and presenting ideas. The areas of ad-hoc network researches are mostly Relatively Static Mesh and some Mobile Military Tactical Network.

ICE855 Special Topic on Wireless Network

ICE856 A Special Topic on All-Digital PLLs

ICE857 Special Topics on Embedded Systems/Software

ICE858 Special Topics on Digital Transceiver

ICE561 Introduction to Electrical Engineering

This goal of this course to describe how and why common-place information systems works and to illustrate how clever engineering solutions can solve technical problems, with minimal reliance on mathematics and science. This course considers systems students encounter everyday,, including electrical switches, digital scale, air-bag inflation system, CD, encryption method, Fax, bar-codes, desk top computers, WWW, and national IT development programs. This course invites each student to think quantitatively and to design useful systems.

ICE570 Introduction to Computer Science

Despite its short history, computers have changed entire human society. Through this course students will embark on a comprehensive study of computer concepts, particularly with respect to computer hardware, operating system,

internet, database, security, and application softwares.

ICE911 Internship Research for Masters

Master research to be familiar with real world problems. Consent of advisor.

ICE912 Internship Research for Ph.D.

Doctoral research to be familiar with real world problems. Consent of advisor.

ICE931 Research for M.S. Thesis

Master thesis research. Consent of advisor.

ICE932 Research for Ph.D. Dissertation

Ph.D. Dissertation research. Consent of advisor.