Information and Communication Engineering

Ⅰ Educational Goal

1) Master Program

① To foster professionals who are able to productively cooperate with people other by understanding the role of information and communication engineer and to them equipped with academic knowledge for advanced study needed in information society.

② To foster excellent R&D engineers who are able to show potential ability in research and development activities in research institute as well as industry by studying theory and practice for implementation.

③ To foster international information and communication experts who are able to do international standardization activities, academic activities and cooperative activities between partners by exercising a foreign language on top of specialty of information and communication engineering.

④ To foster competent engineers who are needed in industry and R&D institute of Daejeon-Chungcheong region by being equipped with industrialized technology and business ability.

2) Ph.D. Program <ditto>

3) Integrated Program <ditto>

Ⅱ Educational Objective

1) To foster sound intellectuals with a foundation of proper values who are able to contribute to academic and industrial technology development of information and communication engineering fields

2) To foster R&D engineers who are able to establish academic knowledge and creatively

apply it for implementation in the area of information and communication engineering.

3) To foster information and communication experts who are equipped with specialty in the areas of internationally comparative advantage and are able to demonstrate potential ability through international activities.

4) To foster proactive and people who are able to contribute to the Daejeon-Chungcheong community and national development by strengthening cooperation among university, research institute and industry.

Ⅲ List of Full-time Faculty

Name	Position	Degree(University)	Field of Instruction	Area of Research
Yun. Young Sun	Professor	Ph. D (KAIST)	Computer Science	Artificial Intelligence, Speech Recognition
Park. Sung Woo	Professor	Ph. D (Univ. of California. Irvine. USA)	Electrical & Computer Engineering	Computer Networks
Eun. Sung Bae	Professor	Ph. D (KAIST)	Computer Science	Computer Architecture
Ryu. Seong Han	Professor	Ph. D (POSTECH)	Electronic Engineering	RFIC & System
Cha. Shin	Associate professor	Ph. D (KAIST)	Computer Science	System safety
You. Dong Ho	Assistant professor	Ph. D (SEOULTECH)	Broadcasting information and communication convergence	Mobile communication system.
Jeong. Gwang Hyeon	Assistant professor	Ph. D (KAIST)	Electronic Engineering	RF circuits and systems.

Ⅳ Course Description

○ Foundation Course

• Advanced Signals and Systems 3 credits

This course provides advanced but necessary subjects of continuous and discrete time signals and systems. The aim of this course is to obtain the analysis and synthesis of the signals and systems effectively. Two parts are divided: comprehensive treatment of continuous-time signals and systems; and the results are extended to discrete-time signals and systems. Various kinds of signals, linear time invariant systems, Fourier serious. Fourier transform, Laplace transform and its applications, elementary discrete-time signals, impulse response, convolution sum for determining the response to arbitrary inputs, Z-transform of discrete-time signals, discrete Fourier transform for finite length sequences, and fast Fourier transform are presented.

• Probability and Random Process 3 credits

A qualitative and quantitative analysis based on statistical modeling will be needed to describe random events occurring in communication and control systems. Real system operation by probabilistic modeling can be predictable within uncertainty level. Statistical description of discrete and continuous signals, modeling of probability density function, power spectrum analysis, application to statistical filtering, interpolation, and system reliability and more topics will be taught.

• Theory and Practice of Image Processing 3 credits

Image processing applications covers a broad range of areas such as imaging science, movie, video, medical imaging, color printer, digital camera, computer vision, internet advertisement, scanner, etc. Main topics include image acquisition, representation, storage, format conversion, image morphing and warphing, data compression and coding, and geometrical image processing, but not limited only to these areas. Software development tools(C/C++ or MATLAB) will be used to develop image processing algorithms and applications.

• Internet Protocols 3 credits

The objective of this lecture is to understand the structure and operating principles of Internet that are recently undergoing rapid growth both qualitatively and quantitatively. The lecture focuses mainly on the IPv4-based TCP/IP protocol stack. Additionally, the emerging technologies such as IPv6 or mobile IP are will be introduced.

• **Advanced Engineering Mathematics 3 credits**

This course is to review and increase the knowledge of engineering mathematics which will be helpful to understand mathematical expressions and their concepts about theories of communication engineering. Topics of this course are similar to those of undergraduate courses on mathematics, except that they are dealt with in more detail.

• **Digital Transmission Theory 3 credits**

The basic structure of digital transmission systems consists of three parts : the transmitter, the transmission channel, and the receiver. For each of these parts there are various signal processing functions being experienced, For instance, digital modulation at the transmitter, signal distortion and noise deterioration through the channel, signal demodulation and detection at the receiver. This course deals with engineering problems for digital transmission systems. Detailed topics to be covered are Fourier transform and signal representation, linear system theory, mathematics on probability and random process, modeling of transmission system, analysis of channel characteristics, optimum design of the transmitter and the receiver, theories of modulation and demodulation, synchronization, error correction coding, and performance analysis of the transmission.

• **Theory of Pattern Recognition 3 credits**

Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data. It encompasses subdisciplines like discriminant analysis, feature extraction, error estimation, cluster analysis (together sometimes called statistical pattern recognition), and grammatical inference and parsing (sometimes called syntactical pattern recognition). Important application areas are image analysis, character recognition, speech analysis, man and machine diagnostics, person identification and industrial inspection.

• **Advanced Computer Architecture 3 credits**

Computer architecture has dramatically evolved since 1990. Superscalar, pipelining, cache, branch prediction, out-of-order execution, and instruction-level parallelism were hot topics in microprocessor design. In class, students focus on advanced computer architecture features for personal computers, servers, and embedded or portable devices. At the end of this course they will understand basic principles in instruction-level parallelism, cache hierarchies, memory systems, storage and IO systems, clusters, and low power design.

○ Intermediate Course

• **RFIC Design 3 credits**

The radio frequency(RF) and wireless market has suddenly expanded to unimaginable dimensions. Devices such as cordless phones and RF identification tags are rapidly penetrating all aspects of life. In this course, overall topics related to the analysis and

design of RF integrated circuits and systems are surveyed. This course begins with the necessary background knowledge from microwave and communication theory and leads to the design of RF transceivers and circuits. This course emphasizes both system architecture and circuit level issues with respect to monolithic implementation in VLSI technologies such as bipolar and CMOS.

• Advanced Digital Signal Processing 3 credits

The aim of this course is to gain a working knowledge of digital signal processing. In particular, graduate students can find their project work involving the aspects of DSP. Therefore this course provides an understanding of the fundamentals such as the sampling theorem and discrete-time signal and systems; discrete transform starting with the DFT and FFT, and the Z-transform and its applications; correlations and convolutions; spectrum estimation and analysis; and implementation and many applications of DSP techniques from a practical point of view.

• Information and Coding Theory 3 credits

Information measure in symbol streams and transmission channel can be computed from statistical characteristics. The course content covers understanding of communication systems in view of stochastic and information theoretic aspect and deals with coding theory to represent information and correct errors that occur during channel transmission. Topics will be shannon channel coding, source coding theory, rate-distortion theory, algebraic coding theory, error correction code and channel capacity based on Shannon coding theory.

• RFID Technology 3 credits

Radio Frequency Identification Technology in the information age plays a central role in constructing sensor networks using electronic tag. The RFID system consists of passive reader and active transceiver. Anti-collision and antenna technology, standardization trends in the related fields, code recognition system, RF sensors, distribution process and tracking will be taught.

• Basic Semiconductor Devices 3 credits

This course is a review of the electrical theory, electronic circuits, and semiconductor devices physics. Student will also review of the semiconductor principles , junctions and MOSFET; the two-terminal, three-terminal and the four-terminal MOS structure; topics on implanted channels and small dimension effects and; large signal and small signal modeling.

• Broadband Networks 3 credits

Today's telecommunication characterizes multimedia services as being personalized and intellectualized, and requiring an underlying communication network to provide much wider bandwidth than ever. Accordingly, the communication protocols become more complicated and must be understood by way of in-depth study. The purpose of this lecture is to study

the broadband networks that support high-speed multimedia services, by to understanding the background theory of broadband communication systems, the organization of broadband networks, and the principles of the related wired/wireless technologies.

• **Advanced Communication System 3 credits**

This course is an overview of architecture and technologies of various communication systems, both wired and wireless. Basic concepts are reviewed on signal spectrum, modulation and demodulation of message signals, characteristics of transmission lines, digital communication systems, which are followed by case studies on communication systems such as telephone system, digital broadcasting, wired or wireless LAN, satellite communication, cellular communication, and optical communication.

• **VLSI Design 3 credits**

Recent development of communication systems is aiming at higher speed of transmission and more complex functions of signal processing. In accordance with this trend, VLSI technology is regarded as the only choice for the realization of high speed complex signal processing. In this course overall topics related to VLSI design are surveyed and design techniques are studied in detail. Namely, circuit design using the VHDL, signal processing logics and their functional expressions, steps of design process for VLSI chips, various CAD tools and equipments, and various examples of VLSI design.

• **Speech Signal Processing 3 credits**

The treatment of speech signal processing requires an initial grounding in digital signal processing. This not only enables students to understand why things appear the way they do in various spectrographic representations, but also allows a proper coverage of basic speech processing algorithms such as linear prediction and cepstral analysis. To introduce the fundamentals of speech signal processing and related applications, this course will present the basic principles of speech analysis and speech synthesis, and it will cover several applications including speech enhancement, speech coding and speech recognition.

• **Spoken Language Processing 3 credits**

This course covers the theory and techniques in spoken language processing, including speech production and perception, speech analysis, enhancement, coding, synthesis, recognition, and language modeling. The course will focus on statistical models of speech and language, including hidden Markov models, EM algorithm, and a number of newly innovated statistical learning algorithms, which are powerful tools for speech processing and beyond. The state-of-the-art spoken language systems and their applications will also be surveyed.

• **Special Topics on Operating Systems 3 credits**

This course is a graduate course on operating systems and software systems in general. This course will cover a broad spectrum of research topics in systems, starting from traditional OS issues and ending with web-related systems. The class will consist of two major thrusts: reading and reviewing research papers, as well as doing a research project.

• Special Topics on Microprocessors 3 credits

Embedded systems are found everywhere -- cellular phones, cars, VCRs, cameras, and all kinds of consumer electronics. The huge numbers and new added complexity requires new technologies and design approaches. The goal of this course is to develop a comprehensive understanding of the technologies behind the embedded systems. The students develop an appreciation of the underlying technology capabilities and limitations of the hardware, and software components for building embedded systems. The students also learn new approaches for building embedded systems and will gain experience on actual system design through several hands-on experiments.

○ Advanced Course Advanced Course

• Analog Integrated Circuits 3 credits

This course covers CMOS analog integrated circuit design techniques using hand analysis and SPICE simulation, reviews the operation of single transistor amplifiers such as CS CG CD amplifiers, frequency response and stability, noise analysis, band gap voltage source and current source bias circuits, single-ended and fully-differential CMOS OP amp circuits, switched capacitor filter, phase locked loop and delay locked loop.

• Computer Vision 3 credits

The most important task in computer vision is to understand the structure of a real world scene given several images of it. Techniques for solving this problem are taken from the geometric principles and their algebraic representation in terms of camera projection matrices. The theory and methods of computation of these entities are dealt with real examples. This course covers: projective geometry, transformations and estimation; camera geometry and single view geometry; epipolar geometry and the fundamental matrix; reconstruction of cameras; structure computation; three-view geometry; and N -view geometry.

• Digital Broadcasting Engineering 3 credits

Digital broadcasting engineering deals with the basic theory of analogue image signal for understanding the image signal, world-wide recommendation of image and voice, kinds of interface of broadcasting fields, digital multimedia broadcasting, digital satellite broadcasting, signal compression technology of image and speech, digital camera, kinds of broadcasting equipments including server for broadcasting, management and editing technologies, and transmission for wave.

• **Digital Filter 3 credits**

Filters are key components in a vast range of electronics; to produce clear sound in music systems; to clean up distortion in radios, televisions, telephones, and so on, as well as all of the communication fields. This course explains how to master analog and digital filter design and implementation. Then students can apply them directly to their own filter design problems. The topics are; an introduction to filters and filter design; analog filter approximation functions; analog lowpass, highpass, bandpass, and bandstop filters; analog filter implementation using active filters; infinite impulse response, digital filter design; finite impulse response digital filter design; digital filter implementation using the FFT.

• **Virtual Reality 3 credits**

Virtual reality is a very powerful and compelling computer application by which humans interact with computer-generated environments in a way that mimics real life. Its most widely known application is in entertainment, medicine, engineering, and the military. Through virtual reality, raising the rate of oil discovery, pilots' dogfight exercising, and improvement of surgeons' skills on virtual patients are possible. This course provides updated and expanded coverage of the technology such as: input and output interface including touch and force feedback, computing architecture, object modeling, programming for virtual reality, in-depth look at human factors issues, and user performance.

• **Mobile Smart Computing 3 credits**

Mobile smart computing addresses integrated emerging technologies through a deeper technical understanding of mobile standards, compliance and best practices, critical thinking skills and tools on mobile web development and applications of the needs of smart mobile users based on cloud web computing environment.

• **Adaptive Signal Processing 3 credits**

Course contents will cover adaptive theory to stationary signal , adaptive signal processing algorithm and architecture, modeling of adaptive system, application to interference cancellation and beam forming, and smart antenna. Also, DSP software and hardware will be considered for design and application on case studies in the area of medical signal processing, mobile communication, telephone line, and beam forming antenna.

• **Mobile Communication Engineering 3 credits**

The course contents will cover historical background of mobile communication systems, an overview of existing mobile communication system, wave propagation and fading, signaling method, CDMA system architecture, multiple access, CDMA network, call processing, handoff, and CDMA performance analysis, and system trends for next generation mobile communication.

• **Digital Image Communication 3 credits**

The course lets the students not only bacame familiarized with the international standards but also provide the underlying concepts, principles, techniques related to video coding. The main contents of digital image communication systems deal with core elements of multimedia technology such as JPEG, MPEG, Digital TV and their techniques and architectures for designing video communication systems.

• **Digital Watermarking 3 credits**

This course provides introductory and applied materials for digital watermarking, steganography, and digital right management. The main issues to be covered will be models of watermarking, error analysis , watermarking methods and security, content authentication, benchmarking techniques, and digital right management for copyright protection and control.

• **Network Simulations 3 credits**

The performances of communication networks are usually evaluated via two methods: mathematical analysis and computer simulations. This lecture helps students learn the generic methodology of simulations and perform various computer-based simulations on the target networks to understand their properties. The simulations can be done using some commercial tools or, if necessary, may be designed in the course of lecture.

• **Protocol Engineering 3 credits**

Being the most essential element in telecommunication, a protocol is a communication rule agree to by two entities participating in information exchange. Therefore, the protocol is conceptually abstract, but takes the concrete form of representation in a simple and explicit way. This lecture is to help students become accustomed to the generic methodology concerning the protocol design, ranging from protocol description to the verification/validation of the designed protocol. For this purpose, students do some case studies on commercially available protocols and try to design a new protocol.

• **Queueing Theory 3 credits**

The queueing theory provides the theoretical basis when evaluating the performance of communication systems by either mathematical analysis or computer simulations. This course covers the principles and the related theories of Markov-based queues such as M/M/1, M/M/m, and M/G/1 etc. Then, by applying is established the queueing theory to the practical communication systems, a theoretical background to compare the performance of communication systems under a variety of traffic scenarios.

• **Wireless Networks 3 credits**

Wireless communication is one area that is rapidly growing. The purpose of this lecture is to understand the architecture and principles of various wireless networks including mobile communication, satellite communication, and wireless CATV, etc.

• **Optical Networks 3 credits**

Using the light wave as a carrier, optical communication systems inherently offer much higher bandwidth than any others. Current communication networks tend to improve its transmission capacity based on the optical fiber and is expected to deploy optical subscriber networks to deliver broadband services to the end users. The purpose of this lecture is to understand the architecture and principles of transmission and switching mechanisms used in optical networks.

• **Wireless Communication System 3 credits**

Wireless communication is one of the hottest topics in recent communication industries from the viewpoint of both service and technology. Developments of technologies for high speed wireless digital communication are actively being undertaken. In this cours,e technologies for various wireless communication systems are overviewed, and standardization activities as well as industry trends are surveyed. Examples of topics to be covered are: types of wireless communication, wireless communication equipments, channel characteristics of the free space, antennas, wireless LAN, mobile communication systems, satellite data communication systems, digital radio broadcasting, etc.

• **Design and Simulation of Communication Systems 3 credits**

Simulations of communication systems are necessary to predict the performance of communication systems under development before their real implementation. Simulation is performed on the platform of software programs, which imitates the communication functions to be developed. In this course, students use a commercial software package for the simulation. Topics to be covered are representation of message signal and its encoding, baseband modulation and demodulation, filtering, modeling of communication channels, multiplexing, multiple access, noises and their cancellation, error correction, synchronization, spread spectrum, and network programming.

• **Modem VLSI 3 credits**

The modem is one of indispensable elements for digital data transmission. Implementation of a modem needs various types of signal processing techniques and VLSI design techniques as well. In this course architectures of modems are explained and signal processing techniques are overviewed briefly. Then various techniques for the design and implementation of ASIC or DSP VLSI functioning modems are taught in detail.

• **Microwave Active Circuit 3 credits**

This course covers the basic concept of microwave active circuit designs such as s-parameter, two-port network, matching circuit and gain/stability of a transistor amplifier. followed by the real circuit design methods for the functional block of microwave transceivers such as broadband amplifiers, LNA, power amplifiers, mixers and oscillator.

• Advanced Communication Theory 3 credits

In communication systems, message signals are converted to an appropriate form of electrical wave and transmitted through channels. Along the path of signal transmission, many sophisticated signal processing techniques are needed in order to accomplish errorless transmission while conversing as much communication resources such as power or spectrum as possible. In this course, theories and techniques for efficient communication engineering are studied. The main issues to be covered are as follows; signal representations either in time or frequency domains, digital or analog modulation of signal, channel encoding, source encoding, information theory, estimation and decision theory, and some examples of communication systems.

• Special Issues on Automatic Speech Recognition 3 credits

This course introduces students to the rapidly developing field of automatic speech recognition. Its content is divided into two parts. Part I deals with background material in the acoustic theory of speech production, acoustic-phonetics, and signal representation. Part II describes algorithmic aspects of speech recognition systems including pattern classification, search algorithms, stochastic modelling, and language modelling techniques. It also introduces the main issues related with the translation of a spoken message into a text. The major problems involved will be presented together with an overview of the most significant techniques used in state-of-the-art automatic speech recognition systems. Furthermore, the course aims at providing students with knowledge for using effective speech recognition technology in real-life applications.

• Natural Language Processing 3 credits

This course provides an introduction to the field of natural language processing (or computational linguistics), including both analysis and generation. Speech processing, machine translation, and computational approaches to language acquisition and language evolution are also given some attention. A wide range of linguistic phenomena, including phonology, morphology, syntax and semantics, and pragmatics, will be treated, and examples will come from various languages. The course also focused on how well particular approaches solve practical problems and how well they model human data.

• Statistical Pattern Recognition 3 credits

Statistical pattern recognition is a very active area of research. Many advances over recent years have been due to the increased computational power available, enabling some techniques to have much wider applicability. This course provides an introduction to

statistical pattern recognition theory and techniques. It encloses discrimination and classification techniques and tries to provide a concise volume containing descriptions of many of the most useful of today's pattern processing techniques including many of the recent advances in nonparametric approaches to discrimination developed in the statistics literature and elsewhere.

• Object Oriented Programming 3 credits

This course shall give an overview of object-oriented programming techniques. Starting with a review of object-oriented design and analysis. The emphasis will lie on object-oriented concepts and their implementation in various languages. Then, implementation aspects of object-oriented languages are discussed and, threads and native interfaces as well, if time permits. The course should give student a good idea of the reasons why the object-oriented paradigm came to be, its strengths and weaknesses, and the trade-offs made by the various implementations.

• Microwave Engineering 3 credits

This course covers theory of transmission lines, waveguides, scattering parameter, impedance matching and design of microwave components such as microwave resonators, power dividers, directional couplers.

• Real-time Systems 3 credits

This course covers recent advances in real-time systems, applications, and services. First of all, theories on real-time systems are suggested. Internal details of Embedded Linux and other commercial real-time operating systems are investigated and the usage of them will be experienced. Term projects on special issues like implementing an embedded system are major works in this class.

• Fault tolerant Systems 3 credits

This course covers the theory on fault-tolerant systems including redundant hardwares, software, techniques for tolerating faults. Also, an implementation technique is introduced using redundant hardwares. The experience of implementing a small active/standby system is major issue in this class.

• Multimedia Database Systems 3 credits

Multimedia data like audio, image, and motion pictures are handled easily in a PC and their usage is broadened to several devices including a variety of hand held devices. In this class, the basic theory of multimedia data handling and database is investigated. Also, multimedia processing and content based retrieval systems for DMB, Digital TV, and Internet TV access are considered.

• Special Issues on Network Management 3 credits

Network management is a crucial point of network implementation. Now, Internet is the only world-wide network and its SNMP protocol has spread into many kinds of network devices. In this class, the theory of SNMP protocol is presented and students will experience the details of implementation of network management protocol. As a term project, an implementation of the agent and manager for a small network device is provided.

• Sensor Networks 3 credits

This course covers recent advances in mobile computing systems, applications, and services. Quality technical papers from major conferences will be used as class materials. Note that this course focuses on systems issues related to mobile computing. Other topics, especially networking aspects of mobile computing (such as wireless networks, mobile networks, sensor networks, ad hoc networks, etc.), are also included in this course.

○ Special Course

• Seminar on Information & Communication I 3 credits

The goal of this course is to obtain knowledge of contemporary interesting topics about the information and communication engineering area. In this course, the students must survey the emerging technologies, present them and perform group discussions on them.

• Advanced Information & Communication I 3 credits

This course introduces the general tendency, the present state, and prospects in information and communication area. It also considers the relationships among the information and communication area, politics, economy, society and cultures. The national policies to industrial growth, transition processes and its suitability are reviewed as well.

• Seminar in selected Topics in Information and Communications I 3 credits

It is required to understanding and application of theory of information and communication along with its rapid expansion. This course studies the techniques of using, developing and applying of satellite communication, fiber network, wireless communication, digital transmission, speech and image signal processing, data network, internet, virtual reality, etc.

• Seminar on Information & Communication II 3 credits

The goal of this course is to obtain knowledge of contemporary interesting topics about the information and communication engineering area. In this course, the students must survey the emerging technologies, present them and perform group discussions on them.

• Advanced Information & Communication II 3 credits

This course introduces the general tendency, the present state, and prospects in information and communication area. It also considers the relationship among the information and communication area, politics, economy, society and cultures. The national policies to

industrial growth, transition processes and its suitability are reviewed as well.

- **Seminar in selected Topics in Information and Communications II 3 credits**

It is required to understand and application of theory of information and communication along with its rapid expansion. This course studies the techniques of using, developing and applying of satellite communication, fiber network, wireless communication, digital transmission, speech and image signal processing, data network, internet, virtual reality, etc.