Dept. of Electronics Engineering

The Department of Electronic Engineering established a master's degree in 1988 and recently produces an average of 30 master's degrees every year, and has continued to develop qualitatively and quantitatively since it established a Ph.D. program in 1992 and produced graduates once in 1996. Moreover, since 2003, it has been subdivided into electronic engineering majors and energy ICT convergence majors to provide more professional and centralized educational programs.
Currently, 26 full-time professors are conducting cutting-edge research to meet the needs of the times in major fields of electronic engineering, and by practicing the tradition of live-action poetry in harmony with academics and practice, they have professional skills. Based on research achievements and industry-academic cooperation results, two teams belonging to the Department of Electronic Engineering were selected for the BK21 core project in 2006, and the excellence of academic initiative and research capabilities has recently been highly praised. In addition, it was selected as an energy Internet ITRC with the support of the Ministry of Science and ICT and IITP, and has recently been highly evaluated domestically and internationally, including industry-academic cooperation-based manpower training projects. After obtaining a degree, graduates of the Department of Electronic Engineering have been actively engaged in various fields such as government agencies, private and government research institutes, large corporations, and venture companies.

❑ **Electronics Engineering Major**

This major division primarily deals with the principal courses and Research topics include Power Electronics, Digital electronics involving the Communication and Signal Processing, Communication system with optics, Automatic and Modern control, Semiconductor with integrated circuit technologies, CAD, intelligent system, and Computer Engineering.

❑ **Energy ICT Convergence Major**

This division primarily deals with the broad area of microwave communication engineering and communication systems. Of these, microwave communication engineering is a field study which explores electromagnetic waves for mobile communication, satellite communication, astronomy communication, and broadcasting. The communication system seeks more efficient and reliable methods of exchange and/or storage of information and knowledge in the form of audio, video, and data. The curriculum covers a broad spectrum of topics, including: RFIC/MMIC, ultra-high frequency, satellite and mobile communications, digital signal processing, networking technologies, and RFID/USN.

☐ **Courses**

❑ **Core Courses**

· **Advanced Power Electronics (3)**

In this lecture, advanced topics in power electronics, including the design of the high efficient power conversion circuits and magnetics in the power converter, will be discussed.

· **Intelligent System Applications in Power Engineering (3)**

This course provides students with fundamental theories about advanced control and optimization methods based on artificial intelligence for power system applications. This course will cover practical issues on smart grid control and operation such as renewable energy control, microgrids, advanced energy management system, ancillary service and so on.

· **DSP Applications (3)**

This course deals with various kinds of application which uses digital signal processing technology. Topics may include but not limited to data compression, speech/audio processing, DSP in digital communication, image/video processing, biomedical signal processing, and hardware implementation.

· **Embedded Control Programming (3)**

This course covers the methodologies for developing control software based on control theory and embedded software theory. Through hands-on practice in processing sensor data and executing control logic on embedded hardware, students will learn the practical aspects of embedded control software development.

· **Semiconductor Physics (3)**

In this lecture, the advanced semiconductor physics will be discussed. Based on the relevant Physics, we will discuss the properties of semiconductor devices including pn-diodes, BJTs, and MOSFETs. Further advanced device physics will also be discussed.

· **Wireless Networks (3)**

The course includes the wireless networks protocols and physical layers for wireless multimedia applications. It covers WLAN, WPAN, ad-hoc networks, and sensor networks. The course also deals with IPv6, Mobile IP, Cellular IP, and QoS MAC protocols.

· **Nanostructure Semiconductor Device Technology (3)**

The principle and applications of nano-structure, nano-scaled semiconductor devices, includong electrical and optical devices, will be discussed in this lecture, based on the advanced quantum mechanics.

· **SoC Design (3)**

The methodology for the IP-based SoC (system-on a chip) design will be discussed in detail. The hardware-description languages of VHDL or Verilog-HDL as a basic design tool for the SoC design will be studied, and the synthesis of digital circuits, verification methods, an auto-placement and routing technique in the layout design will be taught in hand. Some standards for the coding guideline and mixed-mode specs will be also introduced.

· **Mixed-Mode Integrated Circuits (3)**

Main subsystems of the mixed-mode integrated circuits, based on a standard CMOS process, will be discussed. Issues on the design of analog filters adopting switched-capacitor circuits, A/D converters, D/A converters, PLL (phase-locked loop) and DLL (delay-locked loop) will be studied in depth.

· **Next Generation Internet (3)**

We deals with IPv6-based service, Internet architecture, protocols, and standardization. Internet architecture for convergence with wireless networks and broadcasting networks, will be studied. IPv6-based Mobile IP, TCP, traffic management, security, Internet QoS, traffic modeling, VoIP, Dual IP stack, and media independent handover will be studied.

· **Linear Systems Theory (3)**

The course will address both continuous-time and discrete-time representations and both time-invariant and time-variant systems. Topics covered include: (1) Fundamental linear space and matrix concepts: (2) Signal representations, properties, transforms, and sampling: (3) System representations, properties, and transforms. The goal of this course is to provide the beginning EE graduate student with the foundations and tools of signal and linear system theory, necessary for subsequent courses in the overall electrical engineering program i.e., the communications and signal processing program, and control program.

- **Digital signal Processing (3)**

The processing of signals by digital techniques. Topics include discrete-time signal and system theory, the design, analysis and implementation of FIR and IIR digital filters, discrete and Fast Fourier Transforms, and applications to speech, picture processing, and data communications.

- **Vehiclular Network Programming (3)**

This course focuses on vehicle communication programming technologies based on an understanding of automotive network protocols such as Ethernet, CAN, LIN, and FlexRay. Students will learn about in-vehicle communication, vehicle-to-vehicle (V2V) communication, and vehicle-to-infrastructure (V2I) communication.

- **Optimal Control for Electric Vehicle (3)**

This course covers circuit design for electric vehicles and control strategies for energy optimization. Students will learn about electric vehicle applications and control, including battery management systems and motor speed control.

- **Network Synthesis and Filter Design (3)**

This course will cover an introduction which explains the differences between network analysis and synthesis. Butterworth, Chebychev and Bessel filter design are studied in depth for given specifications. Synthesis techniques are dealt with to realize the all-pole filters.

- **High-Speed and High-Frequency Semiconductor Devices (3)**

In this lecture, high-speed and high frequency characteristics of microwave- and millimeterwave devices, such as the compound semiconductor devices, i.e., HEMTs (high-electron mobility transistor) and HBTs (heterojunction bipolar transistors), will be discussed in detail. Moreover, design guideline and implementation method, characterization techniques will also discussed.

- **Application Specific Integrated Circuit Design (3)**

Analog and digital IC designs for a single-chip implementation of the application-specific integrated systems with signal processing, automatic control, artificial intelligence, and image processing.

· **Microwave Circuits Design (3)**

This course focuses on understanding the design theories of impedance transformers, microwave filters, phase shifters, amplifiers, and so on. Furthermore, we lecture the analysis and design methods for various microwave circuits by using computer aided design techniques.

· **Digital Image Processing (3)**

Representation, analysis, and design of two-dimensional signals and systems. Two-dimensional Fourier transform, z-transform, discrete Fourier transform, discrete cosine transform, and fast Fourier transform algorithms. Image processing basics. Image enhancement. Image restoration. Image coding. Additional topics including PC-based image processing systems.

· **Digital Communication System (3)**

This course is devoted to a detailed and unified treatment of digital communication theory as applied to communication system focused on the system reliability. Topics include source coding, signal encoding, representation, and quantization: methods of modulation, synchronization, and transmission: optimum demodulation techniques; and communication through band-limited and random channels.

· **Digital Circuit Design (3)**

Design procedure of the microcomputers based on the synthesis of digital devices will be trained, and its application capability by learning the algorithm of the digital circuit design will be enhanced.

· **Digital Communication Engineering (3)**

This course will deal with PAM, PPM and PDM theory including carrier systems.

· **Application Design for Automotive Software Platform (3)**

This course covers the design of automotive application software based on vehicle software architectures such as AUTOSAR. It addresses topics such as modular software composition and management, as well as the design of network management protocols.

· **Information and Coding Theory (3)**

An exploration of the probability theory in information transmission, covering noiseless source coding theory of ergodic sources and channel coding theorems. Advanced topics in selected areas in signal processing, communication and information theory, decision and control, and system theory.

- **Data Structure (3)**

This course emphasizes the concept of abstract data types (ADTs) and object-oriented design paradigms. The course covers common data structures such as lists, trees, heaps, graphs, etc.

- **Operating System (3)**

This course covers in detail many advanced topics in operating system design and implementation. It starts with topics such as operating systems structuring, multi-threading and synchronization and then moves on to systems issues in parallel and distributed computing systems.

- **Network Architecture (3)**

This course discusses about the concepts and mechanism of computer network systematically and hierarchically according to the computer network's architecture. It covers RS232C, X.25, Ethernet, Token Ring, and TCP/IP as a case study.

- **Real Time Processing (3)**

An introduction to the problems, concepts and techniques involved in computer systems that must interface with external devices: computer characteristics needed for real time use, operating system considerations, analog signal processing and conversion, and inter-computer communication.

- **CMOS RF Integrated Circuits (3)**

This course covers CMOS RF device models, RF transceiver architectures, LNA, mixer, VCO, power amplifier, VGA, filter, PLL, RF package modeling, and so on.

- **Characterization of Semiconductor Materials and Devices (3)**

In this lecture, the methods of analysis, modeling, and parameter extraction for the characterization of electrical and optical properties in the semiconductor devices and their applications will be discussed in detail.

· **Antennas Engineering (3)**

This course covers the basic concepts of antenna and propagation, the numerical methods to design an antenna including frequency domain methods (Moment method) and time domain methods (Finite Difference Time Domain method). This course discuss various antennas in wireless communications, such as small antennas, array antennas, parabolic antennas, planar antennas, etc.

· **RFID System Engineering (3)**

This course covers the basic concepts of RFID system engineering, the RFID system modeling including a reader and a tag, the anti-collision algorithm, the RFID reader and tag architecture, the prediction of interrogation range, the frequency interference due to nearby RFID readers. Also, this course discusses the simulation methods of RFID system using MATLAB.

· **Analog Integrated Circuit Design (3)**

Analog signal-processing chip design based on a standard CMOS process will be discussed in this lecture. In the first, the basic concept of analog signal-processing with various transformation techniques including the z-transform and the op-amp, which is a basic building block in the analog signal processing circuits, will be taught in detail. The concept of the switched-capacitor filter for accurate analog signal-processing and its application analog filters will be also considered in the lecture.

· **Theory of Spread Spectrum Communication (3)**

Topics include synchronization techniques in direct sequence and frequency hopping spread spectrum systems.

· **High Power Switching Circuit (3)**

The design and implementation methodologies of high power conversion circuits employing IGBT and SCR will be covered in this course.

· **Power Electronics System (3)**

This course will provide the specific view of designing UPS, AVR and SMPS.

· **High Efficiency Power System (3)**

This course will handle the methodologies of implementing the high efficiency power system employing the soft switching techniques.

- **Embedded Software (3)**

  This course covers software design methodologies for embedded systems. Students will gain experience in developing embedded software through various software platforms running on real-time operating systems (RTOS).

- **Optical Communication Engineering (3)**

  Principles and applications of LED, LD, optical modulation and demodulation, optical fiber are discussed. Optical communication systems including WDM, SCM, TDM are discussed.

- **Mobile Communication System (3)**

  The course deals with fundamental theory and characteristics of analog communications and digital communications. The course introduces basic concept of cellular, roaming, hand off, and PCS.

- **3D Computer Vision (3)**

  In this course, students will learn 3D computer vision technologies. They will acquire 3D image processing and analysis skills through techniques such as depth estimation, stereo vision, point cloud processing, object recognition, and spatial mapping algorithms.This course covers the use of UML diagrams (such as class, state, and activity diagrams) for modeling the structure and behavior of systems. Students will learn the documentation process of system design by utilizing these diagrams. Additionally, the course teaches techniques for analyzing system design requirements alongside the documentation process using UML.

- **UML Modeling (3)**

  This course covers the use of UML diagrams (such as class, state, and activity diagrams) for modeling the structure and behavior of systems. Students will learn the documentation process of system design by utilizing these diagrams. Additionally, the course teaches techniques for analyzing system design requirements alongside the documentation process using UML.

- **Automotive Electronics Control Programming (3)**

  This course covers software design and programming techniques for controlling various vehicle electronic systems such as brakes, airbags, and automatic steering. Students will learn programming methods for controlling real-time electronic control units (ECUs) based on various control theories, including PID and MPC.

- **Advanced Topics on Embedded Software (3)**

  This course provides an overview of embedded software design concurrent with the embedded hardware design. It covers basically modern methods of embedded software design based on real-time operating system. Also, various topics on RTOS, UML, MDA, platform abstraction, multi-processor SW and their applications will be discussed.

- **Embedded Real-Time Operating Systems (3)**

  This course covers embedded real-time operating system for handset, robot and automobile. Concepts of the embedded real-time operating system will be introduced with embedded system test kits. Also, commercialized embedded real-time operating systems and their applications for handset, robot and automobile will be discussed.

- **Advanced Topics on Intelligent Robots (3)**

  This course provides opportunity to understand theory and practice of the latest intelligent robots. Coverage of this course includes robot navigation, robot control, robot sensing, human robot interaction and other topics related to robot technology in daily life. This course encourages multidisciplinary studies and applications in various fields of robotics.

- **Network Simulation (3)**

  This course deals with the fundamental concept and principles of discrete event simulation. Network simulation methods including ns-2 will be studied. As a case study, we will implement and evaluate network algorithms such as TCP congestion control, buffer management, WLAN, and ad-hoc networks. Then, the way to show the simulation result will be discussed.

- **LED Drive System (3)**

  In this course, we will learn about the fundamental of light-emitting diodes (LED), advanced circuit design and control techniques for LED drive system, and the advanced system analysis methods for performance evaluation of LED drive system.

- **Advanced Microprocessor Design (3)**

  This course provides students with understanding of various microprocessor architectures. It is concerned with the hardware design issues of microprocessor systems: instruction set selection, arithmetic/logic unit design, clocking strategy, hardwired and micro-programmed control systems, memory organization, I/O interface design, and computer simulation of digital systems.

· **Advanced Digital System Design (3)**

This course covers basic concepts and design methodology for digital circuits and systems including automatic synthesis at various levels of abstraction, timing analysis and timing closure, and testing and testable design. This course puts emphasis on providing students with hands-on experience on digital systems. The course includes both lecture and laboratory work on the topics of: hardware description language (e.g., Verilog and VHDL), combinatorial logic, synchronous sequential circuits, algorithmic state machine, and asynchronous sequential circuits.

· **Advanced Topics on Computer Engineering (3)**

This course is designed to cover recent developments and research results in computer engineering.

· **Advanced Topics on EMI/EMC (3)**

This course covers the basic concepts of EMI (Electro-Magnetic Interference) and EMC (Electro-Magnetic Compatibility), the analysis methods in time and frequency domain, and the various techniques to resolve EMI/EMC problems, including crosstalk, shielding, PCB artwork, power supply filters, conducted susceptibility, radiated susceptibility, etc.

· **Advanced Topics on MEMS Engineering (3)**

This course covers MEMS (Micro-electromechanical Systems) technology for wireless and RF applications including MEMS switch, MEMS phase shifter, MEMS inductors, etc. Also, this course discusses the electromagnetic modeling for analyzing MEMS circuits, the reliability and packaging issues, the process methods, and various MEMS sensors such as Gyro and accelerometer.

· **Ultra Low Power Communication Engineering (3)**

This course covers the basic concepts of ultra-low power communications, the link budget calculations, the propagation issue, the transmitter and receiver architecture, the Modem architecture. Also this course discusses the recent wireless specifications including IEEE 802.15.4, zigbee and UWB (Ultra-low power), BAN (Body Area Network), etc.

- **Broadband Communication Systems (3)**

  A broadband communication system utilizing optical signal and optical fiber are discussed. Asynchronous and synchronous systems, ATM, Ethernet, FDDI, Token Ring are among those systems.

- **Integrated Circuit Process Technology (3)**

  Modern CMOS VLSI technology will be covered in-depth in this course to understand the advanced fabrication processes in the current VLSI circuit. In this course, various fabrication processes, including wafering, epitaxial growth, lithography, oxidation, metallization, etchin, and so on will be discussed in detail.

- **Special Topic on Intelligence Systems (3)**

  The course will involve (1) gaining an understanding of the functional operation of a variety of intelligent control techniques and their bio-foundations, (2) the study of control-theoretic foundations (e.g., robustness), (3) learning analytical approaches to study properties (especially stability analysis), and (4) use of the computer for simulation and evaluation. The objective will be to gain a practical working knowledge of the main techniques of intelligent control and an introduction to some promising research directions.

- **Information Security (3)**

  We cover in this course principles and practice of cryptography and network security: classical systems, symmetric block ciphers(DES, AES, other contemporary symmetric ciphers), perfect secrecy, public-key cryptography (RSA, discrete logarithms), logarithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes, and other topics.

- **Computer and Network Security (3)**

  We introduce network security concepts and mechanisms and foundations of computer and network security. We review commonly-used security mechanisms and techniques, security threats and network-based attacks, applications of cryptography, authentication, access control, security protocols, denial of service, web security, the buffer overflow attack, wireless security and privacy, and other topics.

· **Power Semiconductor Devices (3)**

Course work to understand LDMOS, DEMOS, and ultra high-voltage (higher than 700V) devices; structure, material properties, characteristics for practical applications.

· **Power IC Design (3)**

Principles and techniques of design of power electronic circuits in BCD(Bipolar, CMOS, DMOS) process. Circuit issues and practical designs with focus on semiconductor for vehicles, household AC/DC converters, power supplies, and display drivers will be discussed.

· **Topics on Computer Architecture (3)**

This course provides an overview of the concepts employed in the design of high-performance computer systems, with a focus on quantitative analysis of the implications of design decisions and their effects upon design of efficient compilers and operating systems.

· **Research Ethics & Thesis Study (3)**

Graduate students will develop an understanding of the nature of ethical decision-making and its role in research ethics. They will also acquire an appreciation of the reasons for conducting ethical review of research and an awareness of some of the international codes of research ethics that have been developed in response to scandals and abuses in research. Finally, they will understand the nature and definition of research ethics and an appreciation of the importance of good research.

· **Bio-System Control (3)**

In this course we first analyze human physiology from a systems perspective based on mathematical methods. The dynamic models discussed in this course are homeostatic control systems, immune response dynamics, mutation, evolution and so forth. To this end mathematical tools are employed including linear and nonlinear ordinary differential equations, Lyapunov stability analysis, mass action kinetics, and numerical analysis. Then we study applications in biomedical engineering from recent research literature.

· **Automotive Embedded Software (3)**

This course deals with automotive SW platforms, which is one of the most important issues in automotive embedded systems. Based on the SW platform running on multicore processors, students will study the basic concept of automotive SW platform and how to design SW components. Also, application to power train, chassis and body systems will be covered.

· **Semiconductor Convergence Engineering (3)**

For the next-generation semiconductor devices, we will discuss the properties of the emerging semiconductor materials. We will also discuss their applications to broad areas including sensors in this lecture.

· **Device-Circuit Codesign (3)**

We will discuss the advanced and optimization methods of the advenced circuit system for novel semiconductor devices and evaluate the performance of thedesigend circuit system.

· **Special Topic on IT IPR (3)**

This lecture is intended for the Graduate students major in Electrical and Computer Engineering, Information and Communication Engineering to improve and promote the ability in the areas of IT-convergence as well as information technology. The lecture content include the examination of preceding technology of IP(intellectual property), establishment of a IP-oriented strategy, making patent searches, preparing specifications and patent applications.

· **Creation and Application of IT IP (3)**

This course provides the students in the field of electronics, information and communication, and computer with the creation of IPR(intellectual property rights), information retrieval, writing patent application specifications, and answering to the refusal from the examiner concerning the patent application. Practical contents such as the basic writing of patent license contract for the technology transfer will be handled as well.

· **Modern Sensor Technique (3)**

This course aims to provide knowledge of sensor technology. Describe the basic principles, application examples, and the latest trends. Specifically, this course provides an overview of sensor technology, characterization, physical principles, design and detailed description of analytic methods.

· **Intelligent Memory Devices (3)**

Intelligent Memory Devices covers types of memories, geometrical structure, operation principle, and high performance memoriws for promising semiconductor& display systems. In particular, material, fabrication process, device structure, and bias-dependent characteristics of intelligent memory devices are covered.

· **Advanced Display Engineering (3)**

In Advanced Display Engineering, we cover specialized techniques for high-performance display systems. Based on a robust semisonductor devices and current display techniaues, In particular, integrated approach on material-device-circuit are investigated for large scale, high definition, and intelligent display systems.

· **Colloquium for Intelligent Semiconductors and Displays (3)**

In the Colloquium for Intelligent Semiconductors and Displays, experts and engineers specialized in intelligent semiconductor & display systems are invited. Every graduates students in the program is requried to resister and attend.

· **Fundamentals of Artificial Intelligence for Semiconductor Engineers (3)**

Fundamentals of Artificial Intelligence for Semiconductor Engineers is set to provide graduate students working in the intelligent semiconductor&display field with basics of artificial intelligent and its application.

· **Interface Circuits for Semiconductor Memory (3)**

High performance and high capacity memory is required in the intelligent semiconductor& display systems. In this class, Interface Circuits for Semiconductor Memory are covered For better integration of GPU/CPU and memory systems.

· **How to Read and Write Technical Papers (3)**

For well-trained engineers in the field of semiconductor & display systems, it is necessary to accurately read, write, and present research results to other engineers in techanical forms. In this lecture, we train students timely and accurately wirite research result in a technical papers and obtain the intelluctual property for the creative research ouputs.

· **Liberal and Exploratory Research Works (3)**

Students are allwoed to explore creative research topics, organize them as research projects, perform research works, and finally complete the projects as a form of technical papers or intellectual properties in a limited time of one semester.

· **Knowledge of some kind of Communication**

Fundamentals of M2M and IoT will be introduced to understand the core concepts and furthermore. new trends for the M2M, IoT will be discussed.

· **Mathmatics and Optimization in Artificial Intelligence**

This course deals with the mathematical background and optimization methods related to neural networks and deep learning. Students will review and learn concepts on linear algebra including vector space, eigenvectors and eigenvalues, differentiation of matrices, powers of matrices, positive-definite matrices, and singular value decomposition. Students will also learn the basics of non-linear optimization, including gradient descent, Newton's method, convex optimization, etc.

· **Advanced Computer Vision**

This course deals with state-of-the-art methods and theories of Computer Vision including, but not limited to, topics related with camera and image priors, feature descriptors and matching, 3D reconstruction, motion estimation and tracking, image and video classification, segmentation and understanding, detection and localization, as well as basic concepts and theories on deep learning and neural networks. Students will also learn to apply their knowledge to real world problems through programming assignments or image classification, object detection, semantic segmentation, pose estimation, etc.

· **Machine Learning and Deep Learning**

Machine learning is used to recognize faces, recommend movies, and to develop self-driving vehicles. In this course, students will learn key concepts of machine learning. Key methods for supervised learning such as Naive Bayes classification, logistic regression, support vector machines, non-linear regression, and key methods for unsupervised learning such as density estimation, clustering, dimension reduction will be discussed. Recent deep learning methods including convolutional neural networks, graph neural networks, recurrent neural networks, transformer networks, attention mechanisms, etc. will also be discussed. Students will be asked to work on projects that apply these topics to their respective research areas.

· **UAV system Design**

Understanding for UAV development and operation based on basic technology of UAV.

· **Next-Generation Mobile Communication (3)**

This course introduces the basic concepts and principles of 6G mobile communication.

· **Augmented Reality/Virtual Reality/Mixed Reality (3)**

In this course, we study the theoretical background of 3D structure reconstruction and 3D graphics that form the foundation of augmented reality and virtual reality. We also study the core technologies of user interaction and get an overview of the most recent advanced technologies in this field. Additionally, we survey industry trends and discuss design elements for enhancing user experiences.

· **Advanced Automotive Communication (3)**

Through this course, we will explore the landscape of communication in vehicular systems, examining both wired and wireless communication technologies currently in use. The harsh conditions within the vehicle, such as electromagnetic waves and vibrations, have traditionally led to the predominant use of wired networks for in-vehicle communication. However, with the rise of Advanced Driver Assistance System (ADAS) and autonomous vehicles, there is a gradual shift toward wireless networks. In this class, we will study wired communication protocols such as CAN, LIN, FlexRay, Ethernet, and wireless communication, including WAVE and C-V2X, to gain a comprehensive understanding of the communication methods relevant to future automobiles.

· **Mechatronics (3)**

This course covers practical knowledge of the basic elements and design of mechatronics, such as motors and sensors. Students will learn both the theory and practical aspects of real-world applications in devices such as automobiles and home appliances.

· **Automotive Power Electronics Programming (3)**

In this course, students will study the design and programming methods for inverters, converters, and battery management systems. Students will learn about circuit design, programming, and applications in automotive systems.

· **Embedded C Programming (3)**

In this course, students will learn programming techniques for applying C language, which they studied during their undergraduate studies, to embedded systems such as automobiles, smartphones and so on. In particular, they will focus on C programming techniques suited to the characteristics of embedded systems, where resources like memory are limited.

· **Embedded C++ Programming (3)**

In this course, students will learn programming techniques for applying the C++ language, which they studied in their undergraduate courses, to embedded system programming. They will study programming methods for embedded systems, such as AI processors and automotive software, through topics like class design, inheritance, templates, and exception handling.

· **Vehicular Network (3)**

Students will study various protocols and architectural structures used for in-vehicle communication. Through theory and practical exercises on CAN, LIN, and Ethernet, they will develop skills in designing and implementing in-vehicle networks.

· **Automotive Software Platform for OTA and Automated Driving (3)**

Students will study software platforms critical to future mobility, such as OTA updates and Adaptive AUTOSAR, a platform for autonomous driving technology. They will learn about the structure and characteristics of these software platforms and develop design skills using virtual ECUs.

· **Automotive Software Platform (3)**

The course covers the overall structure of vehicle control software platforms, such as Classic AUTOSAR, including the architecture of each layer and development methodologies for platform design. Based on an understanding of these platforms, students will learn the design and development methods for vehicle control systems.

- **Software Engineering (3)**
  In this course, students will learn software engineering for software design. In particular, they will study the entire software development lifecycle, including requirements analysis, system design, testing, and maintenance. They will also work on a project that integrates key elements of software development methodologies, such as Agile, Scrum, and DevOps, while learning to use real-time collaboration tools and version control systems.

- **Automotive System Design based on UML (3)**
  Based on an understanding of UML, the standard for software modeling, students will learn design techniques for automotive systems. They will study approaches to automotive system design using UML diagrams and develop skills in structuring and modeling vehicle systems.

- **Advanced Future Automotive Software (3)**
  Students will analyze the latest trends and technological changes in the future automotive industry, exploring the evolution of automotive software through case studies of new technology applications. They will examine various software application cases in vehicle control, infotainment, and autonomous driving.

- **Practical Training for Future Vehicle 1 (3)**
  In this course, students will participate in real-world vehicle development projects, gaining practical experience in applying the latest technologies in the industry. They will develop skills in prototyping and performance testing of vehicle software, power systems, and controllers that utilize advanced control techniques.

- **Practical Training for Future Vehicle 2 (3)**
  As an advanced course following Future Automotive Field Practice 1, this course focuses on the development of advanced technologies, including automotive AI applications, sensor fusion, Advanced Driver Assistance Systems (ADAS), and in-vehicle infotainment systems. Students will learn project management and problem-solving skills in real industry settings.

· **Advanced Software-Defined Vehicle (3)**

Covers core technologies and architectural design methods for software-defined vehicles, including modularization strategies. Learn through case studies to design and evaluate vehicle software architecture and explore the principles of SDV operation and system integration based on OTA services.

· **Application Services for Vehicular Networks (3)**

Learn about network protocols and communication architectures essential for in-vehicle data transmission and implement vehicle application services based on these protocols. Gain practical skills in designing and implementing in-vehicle network systems.

· **SDV programming (3)**

This course discusses the key technologies and architecture design methods of Software-Defined Vehicles (SDV), as well as modularization strategies. Through application cases, it covers the design and evaluation methodologies for vehicle software architecture and explores the principles of SDV operation based on OTA services and design methods for system integration.

· **Advanced Programming for AI processor (3)**

This course focuses on understanding on-device AI and artificial intelligence processor architecture, and based on this, learning AI algorithm implementation and optimization techniques. It also covers the methods for implementing internal and external communication interfaces for sensor data processing, and how to optimize and implement algorithms for embedded processors.

· **Reinforcement Learning and Applications (3)**

The course covers reinforcement learning methods, which are widely used in various fields such as gaming, robotics, and autonomous driving. Based on reinforcement learning theory, it covers methods for advanced decision-making and solving complex problems in various applications.

· **Advanced Future Automotive SDV (3)**

This course covers the latest technologies and trends in Software-Defined

Vehicles (SDV), addressing various issues such as subscription services, wireless updates, and personalized services. Students will gain an in-depth understanding of the core technologies of SDVs, market trends, and potential future technological developments, providing a strategic perspective necessary for vehicle technology development.

- **Automotive Software Update Design (3)**
  This course covers the practical technologies and strategies required for OTA updates, such as communication protocol design for the latest vehicle software updates and security authentication. The goal is to develop the ability to design vehicle OTA updates using platforms like AUTOSAR and open-source tools.

- **Application Design for OTA and AI Platform (3)**
  In this course, students will learn the design and implementation technologies for vehicle OTA updates and advanced vehicle applications using artificial intelligence, based on the Adaptive AUTOSAR platform. They will gain hands-on experience in updating and managing services through Feature on Demand (FoD) using the UCM module of the Adaptive AUTOSAR platform.

- **Integration Design for Automotive Software (3)**
  This course covers the integration design methods for vehicle software systems. Students will learn how to integrate modularized software and hardware components, and develop their design skills through hands-on projects that involve designing and implementing software architecture for real vehicle systems.

- **Application Design for Automotive AI (3)**
  This course covers how to design vehicle AI services based on sensor data collected from both inside and outside the vehicle for advanced services such as autonomous driving and personalized services. Students will strengthen their ability to develop personalized services operating within the vehicle by applying data analysis and AI algorithms.

- **Practical Training for Future Automotive Technologies (3)**
  This course provides advanced hands-on practice in applying future

automotive technologies in real-world settings. Students will directly apply technologies on-site and participate in projects where they collaborate with industry experts to solve real-world problems.

- **Integrated Training for Future Automotive Technologies (3)**

  This course offers hands-on practice in the integrated approach to vehicle technology, where students experience the design and development of vehicle systems through the integration of various technological fields. Through project-based learning, students will develop the problem-solving skills necessary to tackle complex issues that may arise in real-world settings.

❑ Electronics Engineering Major Courses

- **Low-Power Integrated Circuit Design (3)**

  Low power circuit technology is strongly required to enhance battery lifetime especially in portable devices such as mobile phone and notebook. This power consumption can be divided into two categories of the dynamic and static consumption. Recently developed logic families and clocking strategy to reduce the dynamic power consumption are discussed in this course. In addition, static-power reduction techniques using dynamic threshold-voltage scheme, power cut-off switch, and so on are covered.This course introduces the basic concepts and principles of 6G mobile communication.

- **Memory-Circuit Design (3)**

  Memory devices as a core semiconductor industry, specifically, a circuit design of DRAM will be discussed in the lecture. The principle of the memory cells, cell-arrays, circuit technologies of various peripheral circuits incorporated in the row path, column path, and the performance enhancement strategy of the overall chip in the high-speed DRAMs, including SDRAM (synchronous DRAM) or DDR (dual-data rate) SDRAM, will be considered in detail.

- **Advanced Topics in Integrated Circuit Design (3)**

  The current research trends and problems in modern CMOS VLSI design are discussed in this course. In modern very deep-submicron VLSI design, high-speed signaling and low power issues such as signal integrity, interconnect, power distribution, power consumption, and timing becomes important, as devices go scaled further down. This course aims to introduce the recent design techniques, the optimization algorithms, and the layout methodologies to solve the signaling and low power issues in modern very deep-submicron VLSI design.

· **Modeling and Simulation of Discrete Event Systems (3)**

This course covers the modeling and simulation of discrete event systems specific to computer science and computer engineering. The use of general purpose and specialized languages for these systems will be explored.

· **Algorithms (3)**

The course studies standard methods and examples in the design and analysis of algorithms. Topics include some basic paradigms in algorithm design and analysis of the efficiency and optimality of representative algorithms selected from some of graph, pattern matching, numerical, randomized and approximation algorithms.

· **Network Programming (3)**

This course teaches students to use network programming concepts and techniques, including the Open Systems Interconnection (OSI) seven layer model, plus how to write network programs for both stream and datagram communications with both sockets and Transport Level Interface (TLI), how to use the client-server model in network programs, how to write RPC network programs, and how to implement network security. The course covers network programming facilities in Solaris 2.X, including TCP/IP, UDP/IP, sockets, TLI, RPC, UNIX, and Data Encryption Standard (DES) network security facilities. The courses introduces the basic concept of device driver, socket programming, and application programming. It also covers the internal structure of protocols for implementing application programming such as telnet, ftp, and http.

· **Advanced Topics on PFC Circuits (3)**

Many countries are legislating for limiting the harmonic contents of current flowing into the electronic systems from the power line. In order to meet this regulation, power supply should have power factor correction circuits. This course will cover the principles of various types of power factor correction circuits.

· **Linear System Control (3)**

In this Course, students will understand the mathematical modelling techniques of various type control plant(system), and learn linearization methods of nonlinear system, such as Perturb & linearization, State Space Averaging, Describing function, et al. To control the derived Linear system, students will learn PI, PID, PR, DQ Transform based control methods, computer analysis and controller design procedure using Simulation Tool, and Performance Testing methods including Bode Plot, Time domain response characteristics. Recent technical trends of the supervisory control (event driven control) for communication to high level control, is also included.

· **Automotive Power Electronics System (3)**

In this course, students will learn the various type and operational principles of power electronics systems in the Electric Vehicles, and Hybrid Electric Vehicles. Inverter Techniques to drive the EV motor, PWM, Space Vector Modulation, current control and speed control. Also, the students will learn the converter and modulation technique, and control techniques such as CCCV (Constant Current Constant Voltage) to drive High Voltage Battery used in EV. Various converter method such as resonant converter to small size / light weight vehicles are also included int this course. Various Computer Analysis and design methods will be covered for EV power electronics system.

· **Advanced Topics on Semiconductor Device Physics & Characteristics (3)**

Electrical characteristics of unipolar-type IC devices (JFET, MOSFET, and MESFET), as analog or digital IC components, will be discussed in detail.

· **Advanced Semiconductor Devices (3)**

In this lecture, the current-voltage (I-V) characteristics, capacitance-voltage (C-V) characteristics of semiconductor devices, mainly focusing on the BJTs (bipolar junction transistors) and MOSFETs (metal-oxide-semiconductor field-effect transistors) will be discussed. Non-ideal and secondary effects including the process-related phenomena in the BJTs and MOSFETs will be also discussed in this lecture.

· **Advanced Digital Image Processing (3)**

Topics include optimum prediction for signal processing based on linear and nonlinear time-frequency models, adaptive signal processing, and speech analysis-synthesis based on spectrogram. Additional topics in multirate signal processing.

· **Advanced Control Engineering (3)**

The course presents advanced analytical and logical control techniques with many practical applications. The objective of this course is (1) the introduction of recently developed control theories and successful application examples, (2) the understanding and survey of advanced implementation issues. Systems with delay, systems with noise, and systems with time-varying parameters are considered.

· **Multimedia Engineering (3)**

The course deals with digital multimedia and its applications. The basic characteristics of voice, audio, image, and video that consist of the multimedia are examined and the core of audio and video codec are studied. The joint processing of audio and video is also discussed.

· **Advanced Digital Signal Processing (3)**

This course deals with the advanced topics in digital signal processing area. Topics include spectral analysis, multi-rate signal processing, VLSI implementation, and so on.

· **Advanced Computer Programming (3)**

The goal of this course is to learn advanced programming skills. Students develop programs of practical value, using various programming techniques and software tools.

· **Special Topic on Microprocessor (3)**

The goal of this course is to learn recent research problems and results in the microprocessors and application systems.

· **Embedded System Design (3)**

The goal of this course is to understand system implementation issues of embedded systems, and to exercise various practical design techniques for embedded systems.

· **Digital System Architecture (3)**

The goal of this course is to understand the principles and organization of digital systems, and to learn the performance enhancing techniques and quantitative analysis methods used in contemporary digital systems.

· **Optimal design and operation of microgrid (3)**

In this class, students will learn about the control and operation techniques of microgrid that is composed of renewable energy resources and energy storage system, and learn about optimal design techniques considering the characteristics of target systems such as university campus, hospital, intelligent building and so on. This class will also cover the structure and functions of microgrid energy management system (EMS) based on power system stability analysis and economic dispatch techniques.

· **Introduction to information security**

This course introduces the basic concepts and principles of information security.

· **Blockchain and cryptography**

The course introduces the main ideas underlying blockchains and analyzes the required cryptographic tools.

·**Smart contracts**

The course introduces the concept of smart contracts and describes its development.

· **Applied cryptography**

This course introduces and analyzes cryptographic techniques required in various applications.

❑ Energy ICT Convergence Major Courses

· **Advanced Topics on Multiple Antennas (3)**

This course provides understandings on the basic concept of array antenna, the detection of direction, and the digital beam formation, etc. Also, this course discusses the smart antenna system involving the linear array and circular array antennas.

· **Advanced Theory of Adaptive Signal Processing (3)**

Main topic of this course is the statistical signal processing techniques. This course gives lecture on the various signal processing techniques including the radar signal processing, acoustic signal processing, communication signal processing, bionic signal processing, etc. based on the adaptive filtering discrete signal and system theories.

·**Intelligent Internet of Things**

The basic concepts of IoT and its applications and structural models are taught. Professor introduces AI-based sensing, actuation, processing and virtual physical data communication techniques, prediction and learn techniques for RFID, NFC, barcode, QR code and digital watermarking. This course deals with the conceptual structure of the Internet of Things, the service structure of intelligent sensor networks, and the intelligent IoT platform and applications.

· **Advanced Optical Communication (3)**

Various linear and non-linear properties of optical signals propagating inside optical fiber are analyzed. Attenuation, Dispersion, SPM, XPM, FWM, SBS, RAMAN are among those properties of optical fiber. Estimation and prevention schemes are also discussed.

· **Advanced Topics in Wireless Broadband Communication (3)**

The course covers the key technologies, such as wireless network, real-time signal processing, mobile communications, radio propagation, and integrated and low-power semiconductor technologies, for next generation broadband wireless communications.

· **Advanced Topics in Mobile Communication Engineering (3)**

The course includes fading phenomenon, fading effects and distribution, multiple access cellular system, channel assignment, cellular system design, channel coding and modulation techniques for mobile communications. It also includes traffic engineering, radio resource management, radio interface protocol, and basic concepts and principles for IMT-2000 and systems beyond.

· **Advanced Electromagnetic Engineering (3)**

In this course, we examine the detail analysis methods for boundary conditions of the electromagnetic field on the basis of fundamental electromagnetic theory.

· **MMIC Design (3)**

In this course, analysis and design methods for monolithic microwave active components such as amplifiers, oscillators, and mixes by using microwave CAD software are studied.

- **RF Circuits Design (3)**

  This course provides the design theories for resonant circuits, filters, small-signal RF amplifiers, frequency mixers, RF power amplifiers, and so on.

- **Intelligent Sensor Network**

  Student will study the structure of the sensor network protocol and node being standardized along with a brief application description of the intelligent sensor network. Localization of intelligent sensors, tracking, MAC connectivity, location and energy considerations, integrated networks, operations and control, network platforms and network control will also be learned. Implementation methods for WLAN, cellular networks and smart grid systems.

- **Mobile Computing (3)**

  We deal with the overview and architectural model of distributed and mobile computing. Mobile ad-hoc network, peer-to-peer computing, pervasive computing, context-aware computing will be studied. Also, wireless communication including wireless channel and physical layer, MAC, WLAN, geometric routing, mobile agent technology, mobile IP, mobile information system, mobile distributed system, mobile information management and its application will be discussed.

- **Multimedia Communications (3)**

  The course deals with video compression, multimedia applications, and multimedia information processing and presentation. It also covers multimedia network and protocols, RTP, RSVP, and DiffServ.

- **Special Study on Digital Communication System (3)**

  Study on communication systems utilizing PAM, PPM and PCM.

- **Energy Scavenging Technology for Wireless Communication (3)**

  The goal of this course is to understand the principles of the energy converting to micro electric power, energy management circuitry technologies for this storage, and power management circuitry technologies.

- **Wireless Circuit Design using CAD Tool (3)**

  The goal of this course is to learn how to use the versatile CAD tools for the diverse Wireless Circuit and System design with the higher level understanding the principles of Wireless Communications.

· **Digital RF Technology (3)**

The goal of this course is to understand the concept of the reconfigurable software defined RF technology with the latest digital signal processing and the data converting technologies and to learn the reconfigurable RF hardware system technology.

· **Wireless Energy Transmission Technology (3)**

The goal of this course is to understand the basic principles of the wireless energy transmission with the propagating characteristics of various wireless energy medias such as optimal light, RF/Microwave, and Non-radiative near fields, and to learn the system approaches in analysis and design for the purpose of generating these wireless energy medias effectively.

· **Design Theory of Wireless Communication Filters (3)**

The goal of this course is to understand various wireless communication filters, and to learn image parameter methods and filter synthesis methods including the inverter theories.

· **Special Topic in Broadcasting and Telecommunications Networks (3)**

The course deals with recent developments and research issues in broadcasting and telecommunications networks.

· **Analysis and Optimization of Energy Networks (3)**

The basic theory of queuing and traffic analysis will be taught to theoretically analyze the energy systems and networks. The main algorithms for convex optimization, dynamic optimization, and optimal control are introduced through examples of power systems and energy networks.

· **Energy Information and Communication Technology (3)**

This course introduces convergence technologies for integrated management and operation of distributed energy for improving energy supply/demand/delivery efficiency and reliability. This course also introduces the technologies of ICT-related SW, platforms, wired/wireless communications, and devices which are gradually advanced in the Internet of Energy (IoE) era.

· **Intelligent Energy System**

The energy big data platform consists of an energy convergence service agent, energy data mining, energy production and supply with the demand, and energy information retrieval system. In this lecture, important concepts of intelligent systems such as knowledge representation, exploration, reasoning, machine learning, planning, neural networks, fuzzy theory, and knowledge for building intelligent web-based systems are implemented using SW.

· **New and Renewable Energy Systems (3)**

This course will cover the operating principle of distributed power source using renewable energy such as sunlight, and wind power. We will model the renewable energy sources and define the output prediction model considering uncertainty such as solar radiation and wind speed. This course will deal with the power grid connection process and equivalent circuit modeling process of new and renewable energy sources as well as we will learn control system accordingly. In addition, we will discuss the latest control techniques and energy management system design.

· **Energy Systems Design (3)**

This course will introduce the modeling and simulation techniques for the design of energy systems including solar power, wind power, heat exchangers, freezers, power systems, and thermal process systems. This course will deal with theories and design of new devices such as energy system optimization, economic analysis, and high-density heat transfer equipment.

· **Energy Business Model (3)**

After analyzing energy technology trends, it will deal with energy business models about energy-based new industries in the electric power market. This course regarding business models introduces Energy of Things (EoT), Energy Storage System (ESS), Micro Grid, Virtual Power Plant (VPP), Zero Energy Building, Vehicle-to-Grid (V2G), and Smart City.

· **Advanced Topics in Wireless Network (3)**

Advanced topics in the state-of-the-art network research areas such as next-generation wireless networks, next-generation IMS, SDR, cognitive radio networks, and cross-layer optimization methods will be discussed.

- **Power Conditioning Systems for Wind Power Systems (3)**

  This course provides students with technical knowledge about characteristics of wind turbines and advanced techniques for system design and control schemes for power conditioning systems for wind turbines.

- **Advanced Power Converter Design (3)**

  The course objective is to introduce students to the basic power converter topologies and to analyze and design advanced power conditioning converters. This course covers power electronic devices, regulated bus converters, unregulated bus converters, AC/DC converters, DC/DC converters, AC/AC converters, and resonant converters.

- **Single-Stage Power Conversion Circuit (3)**

  The course objective is to enhance the importance of power factor correction (PFC) by exploring some concepts related to standards, total harmonic distortion (THD) and PFC circuits. The course deals with the concepts and implementation methodology of the single stage PFC converter including analysis, modeling, design, and control.

- **Power System Control and Stability (3)**

  This course is concerned with understanding, modeling, and analyzing power system stability and control problems. Students will learn about steady-state and dynamic models of AC machines and power converters in the beginning of the course. Then, they will learn about fundamental theories about various stability issues as well as active and reactive power control schemes in power systems.

- **Special Topics on Smart Grid (3)**

  This course covers advanced optimization theories for control and operation of smart grids. Advanced topics about smart grids, economic operation of power grids, and power market will be dealt with in this course.

- **Modeling and Analysis of Telecommunication Networks (3)**

  The course covers basic queuing theory and tele-traffic theory for telecommunication networks. It also covers analysis of M/G/1 queue, M/D/1 queue, Priority queue, Polling system, and random access systems.

· **Internet Protocol (3)**

The course covers the OSI reference model, TCP/IP protocol, UDP/IP protocol, and various applications. It also deals with internet performance, QoS architecture, traffic management, performance tuning, and QoS engineering.

· **Power Conditioning Systems for Photovoltaic Systems (3)**

This course provides students with knowledge about fundamental characteristics of photovoltaic systems and advanced control schemes for power conditioning systems of photovoltaic systems. In addition, students will learn about advanced maximum power-point tracking schemes and grid integration techniques.

· **Filter Design for Power Supply (3)**

Various filter circuits in the power supply applications is introduced. Circuit topology, computer analysis, and design methods in terms of the optimization technology will be discussed.

· **Wireless Resource Management (3)**

This course deals with the system level control of co-channel interference and other radio transmission characteristics in wireless communication systems, for example cellular networks and wireless networks. This course also involves algorithms for controlling parameters such as transmit power, user allocation, beamforming, data rates, handover criteria, modulation scheme, error coding scheme, etc. The objective of this course is to utilize the limited radio-frequency spectrum resources and radio network infrastructure as efficiently as possible.

· **ICT Convergence Practice I-1 (1)**

As a Fundmental Practice - I course, ICT convergence knowledge such as information system design and implementation technology, network system analysis and optimization technology, and intelligent management and operation technology are applied to the working environment.

· **ICT Convergence Practice I-2 (2)**

As a Intermediated Practice - I course, the company acquires how to define requirements of ICT convergence industry and the basic theory of field practice, and selects solutions that are necessary for working-level target businesses.

· **ICT Convergence Practice I-3 (3)**

As a Advanced Practice - I course, the entire process of planning, detailed design, development environment construction, development implementation, unit testing, interlock testing, comprehensive testing, interpretation, and evaluation of target solutions is carried out. Practical advanced courses provides opportunities for career exploration and improvement of practical skills.

· **ICT Convergence Practice II-1 (1)**

As a Fundmental Practice - I course, ICT convergence knowledge such as information system design and implementation technology, network system analysis and optimization technology, and intelligent management and operation technology are applied to the working environment.

· **ICT Convergence Practice II-2 (2)**

As a Intermediated Practice - I course, the company acquires how to define requirements of ICT convergence industry and the basic theory of field practice, and selects solutions that are necessary for working-level target businesses.

· **ICT Convergence Practice II-3 (3)**

As a Advanced Practice - I course, the entire process of planning, detailed design, development environment construction, development implementation, unit testing, interlock testing, comprehensive testing, interpretation, and evaluation of target solutions is carried out. Practical advanced courses provides opportunities for career exploration and improvement of practical skills.

·**Introduction to Artificial Intelligence**

In this course, students will learn the background and principles of artificial intelligence and its necessity. After introducing with the basic concepts and design techniques of artificial intelligence, they will be introduced to the broad application fields of AI. Through the acquisition of basic knowledge of psychology and neuroscience, the knowledge-based system is studied through broad and principled consideration of the concept of learning.

· **Machine Learning**

This subject deals with various statistical learning theories and students will learn related concepts such as overview, normalization, and optimization of machine learning. It deals with practical applications for various machine learning problems such as dimension reduction, clustering, and anomaly detection and representative methodologies. It also develops the ability to understand the complexity of machine learning algorithms and analyze performance.

· **Neural Network**

The basic concept and application cases of neural network models, the basic knowledge of deep learning, and the key relation between neural networks and deep learning are introduced. Student will learn about perceptron to deep neural network structures and mathematical modeling of the operation of neurons.

· **Advanced Deep Learning**

In this course, in-depth content on deep learning and various deep learning models applied in various industries are studied in a seminar format.

· **Advanced Topics on Artificial Intelligence**

In this course, students learn in-depth information on artificial intelligence and AI progresses in the recent era and its uses in various industrial applications in a seminar format.

· **IoT Platform**

In this course, to understand the system structure of the Internet of Things (IoT) and implement it as a platform, student will learn HW platform and SW platform. Based on the open source IoT platform, learn how to configure the IoT platform by using the hardware of the IoT device/gateway/server.

·**Bigdata Platform**

In this course, students learn various basic knowledge and various application cases dealing with data and information. They learn about structured or unstructured large-capacity big data analysis techniques to extract meaningful information from data. Based on the basic knowledge related to big data analysis, we learn about the platform for big data analysis of more in-depth content.

· **Artificial Intelligence Platform**

In this subject, student learns the characteristics of system performance that vary depending on the configuration method of the machine (CPU, GPU, and TPU). They will learn to configure learning hardware for a given problem, and learn systematic approaches to processing methods in deep and large-scale data scales about the construction and reasoning methods of probabilistic models.

· **Data Engineering**

In this subject, the entire process from data production to utilization is learned as a field of data science that deals with actual applications of data analysis and collection. In addition, artificial intelligence-based raw data collection, processing, storage, and visualization concepts are also learned.

·**Artificial Intelligence Communication**

Students will learn the applications of AI in communication. To learn how to improve communication performance by sensing the channel intelligently, managing the network resource intelligently, and creating various services by combining the latest wireless communication and networks with artificial intelligence. The principles and types of various artificial intelligence techniques are explained and how these techniques have been applied to the physical layer/network of a communication system is studied.

· **Energy Management System**

In this course, energy resources, energy conversion processes and devices, energy storage and distribution, energy management and energy conservation are studied. Student will learn energy management systems using a variety of artificial intelligence techniques.

☐ Faculty Members

Oh, Ha Ryoung
Seoul National Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Computer Engineering
hroh@kookmin.ac.kr

Seong, Yeong Rak
Hanyang Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Computer Engineering
yeong@kookmin.ac.kr

Kim, Dae Jeong
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Integrated Circuit Design
kimdj@kookmin.ac.kr

Jang, Yeong Min
Kyungpook National Univ., B.S.
Kyungpook National Univ., M.S.
Univ. of Massachusetts, Ph.D.
Wireless Networks and Communications
yjang@kookmin.ac.kr

Park, Jun Seok
Kookmin Univ., B.S.
Kookmin Univ., M.S.
Kookmin Univ., Ph.D.
RF/Microwave Circuit Design
jspark@kookmin.ac.kr

Jung, Kyeong Hoon
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Image Signal Processing
khjung@kookmin.ac.kr

Kim, Dae Hwan
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Semiconductor Devices and Integrated Circuits
drlife@kookmin.ac.kr

Kang, Dong Wook
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Visual Communication
dwkang@kookmin.ac.kr

Hong, Sung Soo
Seoul National Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Power Electronics
hongss@kookmin.ac.kr

Park, Young Il
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Texas A&M Univ., Ph.D.
Optical Communication System
ypark@kookmin.ac.kr

Min, Kyeong Sik
Korea Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Semiconductor and Integrated Circuits
mks@kookmin.ac.kr

Roh, Chung Wook
KAIST, B.S.
KAIST, M.S.
KAIST, Ph.D.
Power Electronics
drno@kookmin.ac.kr

Jeong, Gu Min
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Embedded System
gm1004@kookmin.ac.kr

Jang, Byung Jun
Yonsei Univ., B.S.
Yonsei Univ., D.S.
Yonsei Univ., Ph.D.
RF Engineering
bjjang@kookmin.ac.kr

Han, Sang Kyoo
Pusan National Univ., B.S.
KAIST, M.S.
KAIST, Ph.D.
Power Electronics
djhan@kookmin.ac.kr

Chung, Il Yop
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Power System
chung@kookmin.ac.kr

Kim, Ji Hye
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Univ. of California Irvine, Ph.D.
Security and Privacy, Applied Cryptography
jihyek@kookmin.ac.kr

Choi, Sung Jin
Chung-Ang Univ. B.S.
KAIST, M.S.
KAIST, Ph.D.
Semiconductor Devices and Integrated Circuits
sjchoiee@kookmin.ac.kr

Lee, Soo Chan
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ.., Ph.D.
Computer Engineering
soochahn.lee@gmail.com

Lee, Seong Won
Yonsei Univ., B.S.
Yonsei Univ., D.S.
Yonsei Univ., Ph.D.
Electrical and Electronic Engineering
sungonce@kookmin.ac.kr

Moon, Chan Woo
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Control Engineering
mcwnt@kookmin.ac.kr

Ju, Min Chul
POSTECH, B.S.
KAIST, M.S.
Queen's Univ., Ph.D.
Digital Communications
mcju@kookmin.ac.kr

Chang, Hyuk Jun
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Imperial College London, Ph.D.
Control Engineering
hchang@kookmin.ac.kr

Lee, Seung Min
Sogang Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ.., Ph.D.
Bioengineering
smlee27@kookmin.ac.kr

Kim, Tae Hyoung
Yonsei Univ., B.S.
Yonsei Univ., D.S.
Yonsei Univ., Ph.D.
Communications Engineering
th.kim@kookmin.ac.kr

Han, Yong Su
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Power Electronics
yshan@kookmin.ac.kr

Lee, Yoon Jung
Korea Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Semiconductor Devices
yoonjung.lee@kookmin.ac.kr

Caron, Louis Michel
Ecole Polytechnique de Montreal, B.S.
Physics Engineering(Optics and Solid physics)
Ecole Polytechnique de Montreal, M.S.
Chemical Engineering (Crosslinked Polymer Composite)
lmcaron@kookmin.ac.kr

Mo, Hyun sun
Kookmin Univ., B.S.
Kookmin Univ., M.S.
Kookmin Univ., Ph.D.
Integrated Circuit Design
tyche@kookmin.ac.kr

Jung, Sung Hee
Hankuk University of Foreign Studies, B.S.
Yonsei Univ., D.S.
Yonsei Univ., Ph.D.
Medical Science
sh.jung@kookmin.ac.kr

Kim, Do Hyun
Kyungpook National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Control Engineering
dhkim@kookmin.ac.kr

Lim, Jae Bong
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
RF Engineering
ljb@kookmin.ac.kr

Oh, Jung Hun
Kookmin Univ., B.S.
Kookmin Univ., M.S.
Kookmin Univ., Ph.D.
Signal Processing
omnistar@kookmin.ac.kr

Kim, Chang Wook
Sogang University B.S.
Sogang University M.S.
KAIST Ph.D

Yang, Cheol Kwan
Chung-ang Univ., B.S.
Chung-ang Univ., M.S.
Chung-ang Univ.., Ph.D.
Control Engineering
ckyang@kookmin.ac.kr

Yun, Tae Yun
Seoul National Univ., B.S.
Electronics Engineering

Cho, Hong Goo
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Microwave Engineering
hgcho@kookmin.ac.kr

Sakong, Sug Chin
Korea Univ., B.S.
Korea Univ., M.S.
Korea Univ., Ph.D.
Power Electronics
scsk@kookmin.ac.kr

Kim, Ki Doo
Sogang Univ., B.S.
Pennsylvania State Univ., M.S.
Pennsylvania State Univ., Ph.D.
Signal Processing
kdk@kookmin.ac.kr

Ahn, Hyun Sik
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Seoul National Univ., Ph.D.
Control Engineering
ahs@kookmin.ac.kr

Kim, Dong Myong
Seoul National Univ., B.S.
Seoul National Univ., M.S.
Univ. of Minnesota, Ph.D.
Semiconductor Devices and Integrated Circuits
dmkim@kookmin.ac.kr