❒ **Undergraduate Program**

In the undergraduate program, various fundamental courses in electrical engineering are offered including areas in devices and electrodynamics, systems, and computer and SoC. Basic concepts in analog and digital domain are introduced from devices to systems.

The circuits and systems area is focused on the design and analysis of analog and digital circuits/systems, computer architecture, VLSI design methodologies and computer-aided IC design and software development for VLSI design automation.

The classes provided by the NDIS group cover underlying device physics, semiconductor devices, and device fabrication technology, etc. We aim at providing students a chance to learn relevant theory and principle, to experience hands-on experiments, and to apply for practical cases through taking the courses of 'Introduction to physical electronics,' 'Semiconductor devices', and 'Semiconductor IC technology'. They are useful to cultivate outstanding engineers who are good at semiconductor devices.

The EP (electromagnetics and photonics) group offers undergraduate-level introductory classes on electromagnetics and photonics for fundamental theories and their practical applications. Starting from the mandatory basic electromagnetics, students can learn the basics and applications of electromagnetics and photonics from several introductory classes, such as electromagnetic waves and antennas, radio engineering, introduction to fiber optic communication systems, and fundamentals of photonics.

The communications area is focused on signal processing, probability, digital communication, information theory & coding, and wireless communication. A wide variety of theoretical aspects both for wired and wireless communication technologies are introduced.

The computing, networking and security (CNS) group focuses on the fundamental principles in designing and implementation of modern computer systems, networking end nodes and infrastrtuctures, and recent issues in comptuer/networking security. The CNS group strives to balance the theory and practice of modern computing and networking systems and brings various hot issues in the CNS areas into undergraduate classroom.

The signals and systems area is focused on signal processing and control systems providing theoretical foundations for further studies in speech/image signal processing, pattern recognition and design of control systems.

❒ **Graduate Program**

In the graduate program, the department puts emphasis on cultivating engineers who can play the leading role in the electrical engineering field with thorough knowledge of the fundamental theories and practical capability to solve problems.

➢ Circuits and systems Group
Analog and digital circuit design, VSLI design methodology, Design of Communication, bio/health care, and green-energy systems.

➢ Nano Devices and Integrated Systems Group

Graduate program of NDIS group is based on learning 'Introduction to VLSI devices', 'Modern physics for Engineers', 'MEMS in EE Perspective', 'Introduction to organic devices', 'Display engineering', and 'Photovoltaic power generation'. Afterwards, those classes are extended to 'Solid state physics', 'CMOS front-end process technology', 'High frequency electronics devices', 'Monolithic microwave integrated circuits,' 'MMIC design', 'Optoelectronic semiconductor devices and their applications', 'Advanced MOS device physics', 'Quantum engineering for nanoelectronic devices', and 'Plasma electronics'. By selection of those classes, theory and practice as well as experiment, which are customized for each track of majors, will be deepened and broadened. Through the classes devoted to special topics, recent trends and state-of-the-art technologies based on novel concepts, novel structures, new materials, and new fabrication processes will be covered.

➢ Electromagnetics and Photonics Group

The EP group offers various graduate-level courses and research opportunities for advanced understanding and practical applications of electromagnetics and photonics areas. The first research area (Applied electromagnetics) focuses on the electromagnetics scattering, diffraction, wave propagation, including RF/ microwave and millimeter-wave circuits, antennas, packaging, system, while the second research area (Optics and Photonics) includes photonics, quantum optoelectronics, optical communication, nanoscale optical device, nanophotonics, optical sources, optical MEMS, and biophotonics.

➢ Communications Group

Engineering random processes, detection and estimation, information theory, coding theory, communication theory, convex optimization, queuing theory, linear systems, wireless communication, networking technology and applications, cellular communication systems and protocols, data communication, statistical signal processing, adaptive signal processing.

➢ Computing, Networking, and Security Group

Computer operating systems, system software, computer networks, distributed computing systems, networking algorithms and theory, smart grid systems, cloud computing, big data analysis and algorithms, computer and networking security, electronic device security

➢ Signals and Systems Group

Image and speech processing, pattern recognition, adaptive signal processing, artificial intelligence, neural networks, Brain IT, control systems, intelligent robotic systems, factory automation, power conversion, and motor driving systems.

❒ **Research Groups**

➢ Circuits and Systems Group

The Circuit and systems group focus on enhancing human life quality by the realization of state-of-the-art wired/wireless telecommunication system, bio/healthcare-related system, as well as energy-efficient green environment management system. With such vision in mind, we are striving to contribute in the research areas of digital/analog circuit designs, mixed circuit designs, platform designs, design automation/verification, wired/wireless telecommunication, healthcare, and green-energy systems.

➢ Nano Devices and Integrated Systems Group

Nano Devices and Integrated Systems (NDIS) group focus on improving quality of human life by the realization of state-of-the-art nano device and system technology based on the semiconductor devices and fabrication such as CMOS device, MEMS device, organic device, display technology, energy harvesting device, optoelectronic device, high frequency device, bio/medical/health-care related device and system. NDIS group covers a broad range of fundamental science to applied science and engineering for commercialization by employment of a novel device, a novel structure, a novel concept, new materials, and a novel fabrication technology.

➢ Electromagnetics and Photonics Group

Microwave and photonics group research activities cover the two major areas; the first research area (Applied electromagnetics) focuses on the electromagnetics scattering, diffraction, wave propagation, including RF/ microwave and millimeter-wave circuits, antennas, packaging, system, the other research area (Optics and Photonics) conducts research in photonics, quantum optoelectronics, optical communication, nanoscale optical device, nanophotonics, optical sources, optical MEMS, and biophotonics. Application areas of our group include the physics, devices, and systems using electromagnetics and photonics for various applications including communications, display, energy, environments, imaging, health care, sensing, and security.

- Applied Electromagnetics: Electromagnetics scattering, diffraction, and radiation problems, analytical and numerical techniques of electromagnetics, analysis and design of antenna, precision antenna measurement techniques, beam forming antenna, RFID systems, radar systems, remote sensing, meta-materials, signal and power integrity in 3D ICs, Radio Frequency (RF)/microwave/ millimeter/sub-millimeter-wave's circuits and systems

-Optics and Photonics: Optical Interconnection, optical switching, photonic signal processing devices, optofluidic device for 3D display, semiconductor light sources, terahertz generation and applications, nanoscale optics, Integrated photonics and optoelectronics, optical MEMS, quantum communications, micro/nano-photonics, biophotonics, optical system and network technology, and lightwave systems technology.

➢ Communications Group

Our research interests include the design and analysis of a wide variety of communication systems such as next-generation cellular systems (e.g., 5G systems), wired networks, wireless networks, broadcasting systems, sensor networks, storage systems, and computing systems. We seek to characterize the fundamental limits of information flow for diverse networks, as well as to develop practical transmission/reception schemes that can actually achieve the limits. We are also interested in extending the principles developed in communication networks into other fields of network research. Especially we are recently doing interdisciplinary research on world-wide important topics such as the smart energy network (the so-called smart grid), the smart health-care network, and the smart environment system.

➢ Computing, Networking, and Security Group

The Computing, Networking, and Security (CNS) group focuses its research and education efforts on the hot topics in computer systems, networking, and system security. Its goal is to lead the global research community on the recent hot issues in computing and networking technologies, and to educate the students to become global innovators in this area. Its research topics include operating systems and system software, networking theory and algorithms, networked systems design and implementation, cloud computing, big data analysis and algorithms, smart grid systems, smart mobile systems and so on.

➢ Signals and Systems Group

The Signals and Systems Group researches core theories and technologies needed for the development of signal and information processing algorithms, as well as for the design and implementation of diverse applications. Its areas of research can be divided into two broad categories: information systems and control systems. In the area of information systems, the group carries out research on information and signal processing that involves voice, images, and communication. Specifically, it focuses on voice synthesis and coding, signal processing and prediction, computer vision, pattern recognition, multimedia communication, digital mobile communication, data protection, signal detection and prediction, and 3D image processing. Research related to control systems is focused mainly on robots, power electronics, and control theories used in various intelligent systems and industrial systems. Its examination of process control systems, production line automation, satellite systems, intelligent traffic control systems, power conversion systems, human-centric welfare robots, personal robots, artificial life, inter-robot collaboration, human-robot interfaces, and empathetic robots is aimed at creating an intelligent future environment for humankind.