Descriptions of Courses

RE510 Intelligent Robot Design Lab

This course will provide the methodology of designing and developing an intelligent robot. The objective of this course is to give students a chance to build their own intelligent robot system and demonstrate it. For example, Design and implementation of mobile robot will be performed including procerssor, actuators, sensors, vision, software, and system integration.

MAE553 Robot Dynamics

To develop an understanding and facility with basic analytical tools for the analysis and design of multi-body dynamic systems through robotic manipulators.

MAE655 Robotics Engineering

This course is designed to enable graduate students to understand the most updated topics in kinematics and dynamics of robotics and to apply recently introduced control techniques.

EE683 Robot Control

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

CS 510 Computer Architecture

This goal of this course is to provide the student with an understanding of (*i*) the architectural aspect of the performance issues, and (*ii*) investigation of the full spectrum of design alternatives and their trade-offs.

EE581 Linear Systems

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

RE530 Sensor-based Mobile Robots

In this course, various sensors for mobile robots are introduced, interfacing and system integration technologies are surveyed. Using these sensors, dead reckoning, localization, and map building techniques are studied. Recent topics including motor, encoder, ultrasonic sensor, laser sensor, miscellaneous sensors, interfacing technology, system integration, networking, distributed sensors, and new sensor technology.

RE540 Robot Vision and Sensing

This course describes robot vision technology and other sensing modalities for the perception of an intelligent robot. Specifically, the principles and applications of 3-D vision sensing by multiple CCD cameras will be treated in depth as well as other active range sensing techniques, such as laser range finder, sonar, and RF sensor network.

RE610 Network-based Robotics

This course describes networked environing sensing and actuation, intelligence and control of distributed system, including consistent interaction among man and robot and multi components of the environment. Covered topics include human-robot symbiosis, networked human-robot interaction, network intelligence, reconfigurable software architecture, software platform and standards, networked mobile robots, heterogeneous multi-robot coordination, robot security, and networked-robot applications.

RE710 Artificial Life

This course describes the relationship between the artificial life, artificial intelligence and the intelligence control, and deals with the evolution of the artificial creatures, artificial life & emotion and the problem of the artificial life. Artificial sense organs and brain in the application field accompanied with the IT technology will also be studied. Especially, various parts of the applied robot system including the Humanoid robot will be further discussed for the upcoming robot system.

RE720 Humanoid Robot

This course deals with stable dynamic walking technology of a humanoid robot and its implementation. Kinematics and dynamics of humanoid robot are introduced and ZMP stability is studied as well. Various walking pattern making algorithm is studied in detail, and robot control methods which are indispensable for stable walking are explained in this course.

RE730 Micro/Nano Robotics

As NT(Nano Technology) and BT(Bio Technology) are advancing gradually in 21C, the new concept of Micro/Nano Robotics are created by combining Micro robotics with the NT/BT. This course is designed to give an overview of basic technology and recent developments in the micro/nano robotics, and to practice the realization of new ideas related to this course through the development experiments.

RE740 Evolutionary Robotics

The course deals with the imaginary evolution method of the robot. Related to this, it covers the evolutionary programming, genetic algorithm and design of the fitness function. Strengthening learning method like Q-learning for robots, robot language for interacting with users, the possibility of implementing thoughts and consciousness will be introduced to deal with the evolution, progress, learning and reproduction of the robot.

RE750 Bio-Robotics

The Bio-Robotics is one of the important next-generation robotics research field to overcome the limit of the machinery robot utilizing the flexible locomotion and high-grade recognition ability. This course covers the introduction of the Bio-Robotics, gives lectures about bio-robot design for a cyborg, bionics and brain-computer interaction. For this goal, this course gives a chance to create a simple bio-robot like cockroach and fish that is a combination of control system and bio system.

RE887 Special Topics on Robot Technology

This course is designed to be a survey, presentation, discussion, invited talk, panel discussion and project about selected subjects concerning on 21C intelligence robot technology and its major application fields. Main topics will be humanoid robotics, ubiquitous robotics, HRI, neuro-informatics, applications of intelligent robot and so on.

MAE550 Advanced Dynamics

Kinematics of two and three-dimensional motions of rigid bodies are started with as well as particle motions. An efficient and systematic method for derivation of equations of motion of such a system is studied based on Kane's approach. The most fundamental law, *i.e.*, Newton's 2nd law and other advanced dynamic (Hamilton and Lagrange) equations are covered as well for comparison purpose.

MAE562 Digital System Control

This course introduces the basic concept of discrete time control in the time domain and the state space. the major results of control theory such as stability, observability, controllability, optimality, etc. will be reviewed

for the discrete time case. some other contents included in this course are sampling theory, discrete modeling of the systems, discretization of continuous system, microprocessor applications, etc.

MAE563 Microprocessor Application

This course is designed to give graduate students the ability to understand basic principles of microprocessors and their applications in modern product designs. Prerequisites by topics: basic electrical circuits, computer languages.

MAE662 Design of Precision Actuation System

This course is designed for graduate students. In the beginning, design principles are introduced. Next, several structure design techniques such as kinematic design, flexture mechanism design, guide mechanism design, etc. are studied. Then, error analysis/compensation and uncertainty analysis are covered. In this course, every student proposes a term project and the result of the project is estimated by presentation at the end of the semester.

MAE683 Human Robot Interaction: Haptics

As the human-robot interaction is becoming an important issue for the upcoming human-robot symbiosis era, this year's lecture course is extending the haptic interaction study in human-robot to multimodal interaction. Telerobotics and haptic interaction is the robotics research area that is related with transmission of force or tactile information about remote place or virtual model. The lecture will address fundamental topics about telerobotics and haptic interaction; bilateral control architecture, haptic devices, human haptic perception, haptic modeling, performance evaluation and related applications. Also, various topics in human-robot interaction will be lectured on by joint guest lecturers and with Prof. Kwon.

MAE694 Discrete Event Systems and Applications

This course introduces the discrete event systems theories for modeling, design, analysis, evaluation, and control of systems. The course focuses on Petri-nets-based supervisory control theories with sound mathematical foundation.

MAE761 Nonlinear System Control

This course deals with the contents about the nonlinear system and nonlinear controller widely. Those contents involve the analysis, stability, controller design for nonlinear system and design, analysis for nonlinear controllers.

ID506 Media Interaction Design

This course is designed to study the interactivity of multi-modalities (visual, sound, olfactory, and tactile), and to experience creative interaction design. Emphasis is given to experience tangible interface design with the state-of-the-art of interactive technology.

ID706 Theory of Interface Design

This is an advanced lecture course to study general theories for interface design including human cognitive model, interface design guideline, research methods. Students are to learn interface as a system consisted of human, product, and interface. This interface is viewed in diverse perspectives including intelligent, emotional, social and cultural interface. Final deliverable for student is publication of a paper in a related journal or conference.

EE512 System Programming

This course provides students with the knowledge and skills necessary to build a foundation in system programmings, and is especially focused on operating systems and implementation. Topics include an overview of the components of an OS, concurrency, synchronization, processes, memory management, I/O

devices, and file systems.

EE516 Computer Applications Lab.
In this course, the fundamental commands and the Kernel programming of Linux OS will be practiced on a ARM based embedded computer. It covers the system call generation, the module programming, and the programming of character device drivers, block device drivers, and interrupt handling.

EE525 Networking Technology and Applications
Topics covered in this course include timing recovery, channel equalizer, speech codec in wireless communications, electronic switching system, router, protocol design and validation, network simulators, data transmission using Winsock, Linux porting and Linux routing, network device driver, CDMA base transceiver system, and network management.

EE535 Digital Image Processing
This course deals with the fundamental concept of digital image processing, analysis, and understanding. Topics include sampling, linear and nonlinear operations of images, image compression, enhancement and restoration, reconstruction from projections, feature extraction, and image understanding.

EE538 Neural Networks
This course covers the theory and application of neural networks. In particular lectures explore the structure and function of neural networks and their learning and generalization. Also various models of neural networks and their applications are illustrated.

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

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

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

EE735 Computer Vision
This course will explore the principles, models and applications of computer vision. The course consists of five parts: image formation and image models; generic features, such as edges and corners, from images;

the multiple view analysis to recover three dimensional structure from images; segmentation of images and tracking; the object recognition methodologies. (Prerequisite: EE535)

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

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

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

CS 520 Theory of Programming Languages
This course reviews design principles and implementation techniques of various programming languages. This course also introduces a wide spectrum of programming paradigms such as functional programming, logic programming, and object-oriented programming.

CS 530 Operating System
The main focus of this course is to understand the concurrency features of modern operating systems. Concurrent programming is dealt with in detail to simulate various parts of an OS. Other topics that are required to understand the process-oriented OS structure are also discussed.

CS 570 Artificial Intelligence
The goal of this course is to give both a comprehensive introduction to core concepts of AI and hands-on experience in symbolic language programming. This course not only provides a thorough discussion of AI's foundational technologies including predicate calculus, search, and AI languages, but introduces processing, pattern recognition, computer vision, and neural networks.

CS 540 Network Architecture
The goal of this course is to provide students with an understanding on the following topics. (1) the concept of layered architectures, (2) the design and implementation of communication protocols, (3) the multimedia communication protocol, and (4) the design of high-speed protocols. The course also covers many aspects of protocol engineering: design, implementation and test of communication protocols.

CS 576 Computer Vision
The goal of this course is to provide students with theory and application of computer vision. Major topics include digital image fundamentals, binary vision, gray-level vision, 3-D vision, motion detection and analysis, computer vision system hardware and architecture, CAD-based vision, knowledge-based vision, neural-network-based vision.

CS 580 Interactive Computer Graphics
This course presents the principles of three-dimensional graphics, including geometric, modeling and realistic image synthesis. It also covers techniques for representing, manipulating, and rendering three-dimensional

objects.

CS 610 Parallel Processing
This course discusses both parallel software and parallel architectures. It starts with an overview of the basic foundations such as hardware technology, applications and, computational models. An overview of parallel software and their limitations is provided. Some existing parallel machines and proposed parallel architectures are also covered.

CS 642 Distributed Processing Systems
This course covers various high-level issues in distributed processing. We also analyze ISO / OSI upper layers (presentation, application layer protocols) and document switching systems.

CS 655 System Modeling and Analysis
Today's information systems are getting more complex, and need for automation systems is ever increasing. In this couse we address basic modelling methods in system analysis and study static and dynamic analysis of systems using Petri Net.

CS 670 Fuzzy and Intelligent System
The aim of this course is to introduce basic concepts and knowledge of the fuzzy theory and its applications. This course also covers some important intelligent systems including the neural network model and genetic algorithm, and the fusion of the different techniques will be discussed.

CS 676 Pattern Recognition
Through this course, students are expected to acquire general ideas of pattern recognition and its application. Three fields (character, speech and image processing) will be studied in which pattern recognition techniques can be successfully applied.

CS 678 Intelligent Robotics
The goal of this course is to provide students with state-of-the-art technologies in intelligent robotics. Major topics include sensing, path planning, and navigation, as well as artificial intelligence and neural networks for robotics.

CS 774 Topics in Artificial Intelligence
This course covers advanced topics of interest in artificial intelligence.

CS 776 Topics in Cognitive Science
This course is designed to cover topics of interest in cognitive science.

CS 780 Topics in Interactive Computer Graphics
This course is designed to cover recent developments in interactive computer graphics.

BiS571 BioElectroMechanics
This course provides electromechanics for understanding and analysis of biomechatronic systems. An analogy between mechanical systems and electrical systems, modeling of electromechanical systems, and working principles of biomedical, diagnostic, surgery and therapeutic equipments are discussed.

BiS623 Bioelectronic Devices
This course covers advanced topics in the design and industrial application of bioelectronic devices such as biosensor and biochip. The fundamental principles in these areas have emphasized to understand the

biological recognition mechanism of enzyme, antibody, microorganism, animal cell, and DNA.

BiS651 Hearing and Auditory Model

We study basic concepts of acoustic wave propagation and scattering, and human auditory systems based on cognitive, acoustic, and signal processing perspectives. By analysing huge amounts of cognitive science experimental data, we propose mathematical models for non-linearity, time-adaptation, masking, etc. Also, the connection of this data to information theory is investigated, and finally, applications to speech recognition are studied.

BiS652 Human Visual Model

Human visual system is studied with cognitive scientific and signal processing perspectives. By analysing huge cognitive science experimental data, we will come up to mathematical models. Also, its connection to information theory is investigated, and finally applications to real-world image recognition and target tracking are studied.

BiS653 Biomedical Imaging System

Theory and applications of several biomedical imaging systems are studied. Especially, X-ray imaging, ultra-acoustic imaging, X-ray CT, MRI, PET, and PACS are discussed.

RE960 Thesis Research(Master)

RE966 Seminar(Master)

RE980 Thesis Research(Doctoral)

RE986 Seminar(Doctoral)