# 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 processors, actuators, sensors, vision, software, and system integration.

**EE581 Linear System**

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.

**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)

**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.

**CS510 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.

**CS570 Artificial Intelligence and Machine Learning**

Classical artificial intelligence algorithms and introduction to machine learning based on probability and statistics.

**ME553 Robot Dynamics**

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

**ME655 Robotics Engineering**

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

**RE502 Sensor & Sensing**

Sensor technology is one of the essential components in modern intelligent robot technology. This

course first reviews some of the classical sensors including location, tactile, laser, and ultrasound sensors. Then, this course mainly focuses on in depth discussion on modern imaging sensor technologies such photodetecors, CCD, CMOS, etc.

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.

**RE722 Robot Vision and Digital Image System**

Through the investigation on the robot intelligence area and the implementations of various robot vision systems which are being practically applied, students learn how to use/apply the developed technologies. Finally, this course encourages students to be experts who are able to develop a creative robot vision system.

**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.

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.

GT508 Navigation and Sensing Systems

This course introduces GNSS (Global Navigation Satellite Systems), radar, and image processing technologies for vehicular navigation systems. Study subjects include the principles and signal analysis of the next generation GNSS, principles and signal processing techniques for radar, and the principles and image processing techniques for vision navigation

GT560 The Principles and Applications of the Calman Filter

The aim of this course is to provide a thorough introduction to the Kalman filter technique that is an essential tool for state estimation and optimal control. In addition, this course covers the applications of the Kalman filter for linear and nonlinear systems such as extended Kalman filter, unscented Kalman filter, robust Kalman filter, multi-model Kalman filter, and particle filter

MAS565 Numerical Analysis

This course introduces computational linear algebra and finite differential methods. It also provides a basic foundation in numerical methods for scientific computation. Topics include matrix computation, Gaussian elimination, Choleski decomposition, LU decomposition, banded system block tridiagonal systems, the Gauss-Seidel method, the Jacobi method, block interaction, error analysis, interpolation theory, the approximation of functions, root-finding for nonlinear equations, numerical differentiation and integration, and stability

IE561 Advanced Information System Engineering

The course teaches professional knowledge and methodologies for design and development of various complex information systems, which utilize data, information, and knowledge for system operation and decision, such as business information systems, manufacturing information systems, service operation systems, distributed simulation systems, and decision support systems. The topics are state-of-art system engineering and SW engineering methods and tools including customer and user identification, user requirement definition, functional requirement specification and functional design, SW architecture design and functional specification, process/object/service/scenario/data modeling, model-based architecture & engineering, BPM(Business Process Management), web services, SOA(Service Oriented Architecture), communication architecture and application services, real-time and distributed applications, interoperability, verification and testing, middleware, knowledge engineering processes for large-scale system modeling & design, standards, and so on. Cases and labs for some of BPMS, geometric modeling systems, PLM(Product Life Cycle Management) systems, semiconductor fab planning and control system, automation SW systems, real-virtual integrated
distributed simulation systems, user interfaces, etc are included. The focus and cases can be

accommodated

**IE761 Cognitive Engineering**

Approaches to enhance human performance in problem solving and decision making by computer and other methods are considered. Systems engineering point of view is exercised while covering models of human and machine intelligence, prescriptive and descriptive theories of human decision making, and models to combine human and machine resources. Application-oriented issues are emphasized

**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 conferen.

**EE414 Embedded Systems**

In this lecture, various hardware and software components and system implementation aspects of embedded system are covered. Covered topics inlcude bus-based expandable ARM processor based board, open-source embedded Linux operating system, PC-based software development environment, digital and analog interface techniques, ARM assembly language, device drivers. Hands-on experience is gained to enhance firm understanding.
(Prerequisite: EE303)

**EE481 Intelligent Systems**

Two major themes of this course are 'Modern Control System' and 'Computational Intelligence'. Each lecture will address a balanced emphasis on the theory about the control system and its applications in practice. The first part of this course includes digital control system design and state-space methods for control system design. The basic system identification scheme will also be included, considering the control of unknown systems. Once background knowledge of the modern control system is established, this course will then focus on the second part composed of computational intelligence using fuzzy logic, artificial neural network and evolutionary computation as main topics to introduce recent trend in intelligent control. Term projects will be assigned to test the algorithms to the given problems. (Prerequisites: EE381)

**EE516 Embedded Software**

This lecture covers the topics of embedded software programming including Linux basic commands, shell programming, kernel structure, interprocess commuication, file system, device drivers, and bootloader structure. Each students will practice to implement the lectured topics on a embedded computer to be a real embedded system programmer. (Prerequisite: EE209)

**EE531 Statistical learning theory**

Introduce students the fundamental concepts and intuition behind modern machine learning techniques and algorithms, beginning with topics such as perceptron to more recent topics such as boosting, support vector machines and Bayesian networks. Statistical inference will be the foundation for most the algorithms covered in the course.

**EE533 Digital Speech Processing**

This course explains how digital signal processing techniques can be applied in the field of speech communication. The initial part of the course covers some background material in signal processing and the acoustic theory of speech production. Later lectures cover coding, recognition and synthesis of speech. (Prerequisite: EE202)

**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.

**EE573 Introduction to VLSI Systems**

This course covers the role, application and various issues in the design and verification of various VLSI chips including SoC (System-on-Chip). Additional topics include HW / SW co-design and co-verification, full-custom design, reconfigurable systems, low-power system, interconnection and packaging, clock distribution, VDSM (Very Deep Submicron) issues. Students will be given two opportunities for poster and oral presentations, respectively, on the topic of his / her choice within the course subject.

**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.

**EE591 Introduction to Electric Vehicles**

This course introduces electric vehicles consisting of two major subtopics: general knowledge of vehicles (chassises, drivetrains, electronics control units, and etc.) and electric vehicle E/E (electrical and electronics) architectures (electric motors, drivers, batteries, BMS, etc.).

**EE594 Power Electronics Systems**

This course covers the design and analysis of the topology about the DC / DC converter, PFC (Power Factor Correction) circuit and control methode in that topology. Also the topology such as inverter, resonant converter, and active power filter is introduced, and the control algorithm of that topology is studied in this course. Finally the state of the art in power conversion system is discussed, and every student carries out a term project about design and modeling of power supply. On completion of this course students will have built confidence on their ability to design and analyse the power conversion system.
(Prerequisite: EE391)

**EE667 Multiple View Geometry**

This course deals with fundamental concepts of multiple view geometry for 3D computer vision, such as projective geometry, transformation, estimation of the transformation parameters, camera

model and camera matrix, epipolar geometry, fundamental matrix, trifocal tensor, and 3D Structure computation, and so on.

**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)

**EE688 Optimal Control Theory**

This course deals with the derivation of maximum principle and the design of optimal control system. It includes an optimal design method for minimum time and energy along with dynamic programming and discrete maximum principle. Also advanced topics of optimal control are introduced. (Prerequisite: EE581)

**EE734 Image Understanding**

This course explores the theory and methodologies used to interpret images and videos in terms of semantic content. Techniques from pattern recognition are introduced and discussed to explain how to apply them for image understanding. (Prerequisite: EE535)

**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** Medical Imaging Technology

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.

**EE739 Cognitive Information Processing**

This course discusses cognitive information processing mechanism in our brain and computational models for human-like cognitive systems. We will first discuss neural data representation, and move to the models of perception, attention, socialization, memory, learning, reasoning, and problem solving.

**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)

**EE827 Special Topics in Communication**

This course covers topics of interest in communication engineering at the graduate level. Course content is specifically designed by the instructor.

**EE837 Special Topics in Signal Processing**

This course is to introduce some important topics in the general area of communications and signal processing. Topics may vary from year to year.

**EE838 Special Topics in Image Engineering**

This course introduces a selected topics of recent technologies and algorithm related to image processing and imaging systems. (Prerequisite: EE432, EE535)

**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.

**CS470 Introduction to Artificial Intelligence**

This course introduces basic concepts and design techniques of artificial intelligence, and later deals with knowledge representation and inference techniques. Students are to design, implement, and train knowledge-based systems

**CS520 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

**CS530 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

**CS540 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

**CS543 Distributed Systems**

This course provides theoretical knowledge and hands-on experience with distributed systems' design and implementation. The course will focus on the principles underlying modern distributed systems such as networking, naming, security, distributed sychronization, concurrency, fault tolerance, etc. along with case studies. Emphasis will be on evaluating and critiquing approaches and ideas. (Prerequisite: CS510, CS530)

**CS570 Artificial Intelligence and Machine Learning**

Classical artificial intelligence algorithms and introduction to machine learning based on probability and statistics

**CS572 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.

CS576 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.

CS580 Computer Graphics

We will study fundamentals of computer graphics and their applications to games, movies, and other related areas. In particular, we will study different branches, fundamentals, rendering, animation, and modeling, of computer graphics. Also, CS580 can be taken by students who have not taken any computer graphics related courses in their undergraduate courses

CS600 Graph Theory

This course is intended as a first course in graph theory. It covers the basic theory and applications of trees, networks, Euler graphs, Hamiltonian graphs, matchings, colorings, planar graphs, and network flow.

CS610 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

CS655 System Modeling and Analysis

Today's information systems are getting more complex, and need for automation systems is ever increasing. In this course we address basic modelling methods in system analysis and study static and dynamic analysis of systems using Petri Nets

CS670 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

CS672 Reinforcement Learning

This course covers reinforcement learning, which is one of the core research areas in machine learning and artificial intelligence. Reinforcement learning has various applications, such as robot navigation/control, intelligent user interfaces, and network routing. Students will be able to understand the fundamental concepts, and capture the recent research trends

CS676 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.

CC686 Motion Planning and Applications

In this class we will discuss various techniques of motion and path planning for various robots. We go over various classic techniques such as visibility graphs and cell decomposition. In particular, we will study probabilistic techniques that have been used for a wide variety of robots and extensively investigated in recent years

CC688 Large-Scale Image & Video Retrieval

In this class we will discuss various techniques related to image/video retrieval. Especially, we will go over image/video features (e.g., SIFTs and GISTs), their indexing data structures, and runtime query algorithms. We will also study scalable techniques that can handle large-scale image/video databases, in addition to looking into novel applications of them

CS770 Special Topics in Computer Vision

This course consists of lectures about major topics related to computer vision, seminars, and projects. Recent major topics are motion detection and analysis, parallel computer vision systems, CAD-based 3-D vision, knowledge-based vision, neural network-based vision, etc

CS774 Special Topics in Artificial Intelligence

The goal of this course is to provide students with recent theory of AI and its application. It covers information representation. heuristic search, logic and logic language, robot planning, AI languages, expert system, distributed AI system, uncertainty problem and so on.

CS776 Special Topics in Cognitive Science

This course defines humans' cognitive ability, and then studies a variety of methodologies by which cognitive psychology, artificial intelligence, computer science, linguistics, and philosophy apply this ability to machines. This course focuses on 'neural networks' as a computational model of the brain and as a method for approaching fields that computers cannot solve efficiently, such as pattern recognition, voice recognition and natural language processing.

CS780 Special Topics in Interactive Computer Graphics

This course covers advanced topics of computer graphics such as modeling geometric objects, rendering and processing three-dimensional objects, and manipulating motion. The course surveys and analyzes recent results, and discusses the research focus for the future.

CE551 Soft Computing Techniques for Engineering Design

This course deals with various numerical and combinatorial optimization techniques for solving engineering and structural design problems. This course puts emphasis on the most recent AI (artificial intelligence) and soft computing-based optimization techniques such as neural networks, deep learning, fuzzy logic, and evolutionary computation (EC) as well as classical optimization techniques.

CE554 Mechanical Design of Civil Robot

This course deals with mechanical design methodologies of various robots. Robot manipulator, Legged robot, wheeled robot, micro/nano robot will be studied in the view point of mechanical design.

CE558 Introduction to Civil Robotics

This course is targeted to familiarize graduate students with applied robotics other than EECS and ME. This course helps students understand general civil robotics issues and apply robot techniques to civil engineering application area. Specifically the students can understand fundamental principles of robotics by simulating their application world with robotics simulation tool.

ME453 Introduction to Robotics Engineering

In the robot motion, one will analyze the static and spatial restriction factors deal with basic robots design and application.

ME505 Measurement Instrumentation

Basic principles, concepts, and methods of measurement instrumentation of physical quantities dealt with significance in mechanical engineering are introduced. Emphasis is given to the measurements

of lengths, forces, and temperature with mechanical, electromagnet, and optical instrumentation technologies.

ME550 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

ME559 Dynamics and Control of Ocean Vehicles

This course offers a comprehensive overview of dynamic modeling, analysis and control system design for ocean vehicles. It will provide students a theoretical foundation and understanding of the concepts involved in classical and modern control theories which can be applied to all types of ocean vehicles including surface vessels and manned/unmanned underwater vehicles. The topics of this course include: kinematics, rigid body dynamics, vehicle dynamics modeling, stability/controllability analysis, introductory control and estimation techniques, and some specific control application examples

ME562 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.

ME585 Mechanics and Control of Human Movement

This course covers methods for modeling and analyzing human movement as biomechanical systems. Topics to be covered include dynamics of body segments, kinematic analysis, forward dynamics simulations, inverse dynamics, control analysis, and muscle mechanics. The course also includes the topics on central nervous system as well as sensory organs

ME600 Mechanical System Design Project 1

The course aims to provide the students who have declared to take the Renaissance program and have already taken the core course "Collaborative System Design and Engineering" and the departmental system design course with the opportunity to take practice in their own design project(s) based on the collaborative creativity and teamwork by forming relevant team(s) of the similar topical category through practices and discussions. The implementation of the cycle operation in knowledge creation would be
made in common effort for two cycles.

ME601 Mechanical System Design Project 2

(6)The course aims to bring advancement and improvement of the works from the preceding semester of the same teams to attain the advanced level by continuing the knowledge creation process with renewed two cycles through practices and discussions and by operating the project in common effort

ME642 Medical Biomechanics

Study the structure, function and its behavior of human musculoskeletal system, identify the physical problem of musculoskeletal system to find contribution in solving those problems applying mechanical principles

ME652 Mobile Robotics

Fundamental concepts and design principles of mobile robotic systems are introduced, and various mathematical techniques and algorithms for mobile robots and vehicular systems are described. The specific topics of this course include vehicle guidance and control, path planning algorithms, and probabilistic robotic techniques for mobile robot applications.

ME654 Noise Control

Various environmental pollutions are being concerned very much along with the fast development of industry and living standard. Among various pollution topics, 'noise', in particular from various mechanical systems, becomes a big concerning item to generals and manufacturers because the machine noise is usually directly related with the ordinary life of human beings. Quietness of machines becomes one of quality and market value evaluation points of a machine and the customers and regulations demand a lot of noise-related functions to the machine manufacturers. In this course, for the high value design of machines and the quietness of everyday life and environment, source characteristics, human perception characteristics, identification of noise sources and transfer paths, product sound quality, and countermeasure plans are studied, which should be in mind for a noise and vibration engineer.

ME662 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 dealt with. 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.

ME683 Human Robot Interaction: Haptics

As the human-robot interaction is becoming the important issue for the upcoming human-robot symbiosis era, this year's lecture 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 jointly with guest lecturers and Prof. Kwon.

ME761 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 the nonlinear system and design, analysis for the nonlinear controllers

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..

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 Advanced MRI Techniques**

This class covers the basic MRI principles and advanced MRI techniques including angiography, diffusion-weighted and diffusion tensor imaging, perfusion-weighted imaging, functional MRI, etc. Students will be asked to perform pulse sequence programming for some of these imaging techniques to be implementable in an MRI equipment

**BiS673 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