Descriptions of Courses

❒ Undergraduate

ME106 Human and Machine **3:0:3(3)**

This course is designed to provide freshmen with perspectives, directions and methods necessary to help them pursue successful careers, not only as students at KAIST, but ultimately as responsible and competent professionals. To this end, this course covers: goal-setting method for life planning, strategies for a successful career, and time-management skills; and systematic methodologies for analysis and design. This deals with the various attributes of mechanical civilization to identify the advanced civilization in which the scientists and engineers drive the main stream. Cultural attitude and technical methodologies are studied to secure the leadership of engineers.

ME200 Basic Mechanical Practice **2:3:3(3)**

This course concentrates on the basis in modelling and realization of mechanical components. This can be divided into the tasks of CAD and manufacturing. We will cover the former by pursuing a sequence of design examples and the latter by manufacturing the design example.

ME203 Mechatronics system design **2:3:3(6)**

This course introduces methods and techniques to interface and control mechatronics systems using Arduino. The course will also briefly introduce how to design and prototype small parts using 3D design softwares which is needed to build mechatronics devices. This course focuses more on laboratory and term projects so that students can have hands-on experience of implementing mechatronics systems.

ME205 Mechanical Engineering Laboratory **2:3:3(6)**

Various equipments will be applied to explain the essential experiments in mechanical engineering. Measurement and processing of data will be carried out using PC and LabView. It will be trained; systematic way to select the measurement parameter, to collect and process the data, and to report and present the experimental results.

ME211 Thermodynamics **3:0:3(6)**

Fundamental concepts and definitions of material and its properties. Basic understanding of energy conversion problems. Formulation of 1st and 2nd laws of Thermodynamics, and application to engineering systems. Definition of material properties including energy and entropy, and concepts and calculation procedure of heat and work as applied to the thermodynamic systems. Application systems include the gas and vapor power cycles and refrigeration cycles. Some general introduction to the issues of energy and environment.

ME221 Fluid Mechanics **3:0:3(6)**

Fundamental concepts of fluid mechanics, fluid statics, basic equations in integral form, basic equations in differential form, Bernoulli equation, dimensional analysis and internal viscous duct and boundary layer flow.

ME231 Solid Mechanics **3:1:3(6)**

The basic structural mechanics modeling will be covered to learn the various materials behavior systematically. Through its application the formation of various structural components and parts will be analyzed and understood.

MAE251 Dynamics **3:0:3(6)**

Introduction of dynamic systems for motivation enhancement. Kinematics of rigid bodies including velocity and acceleration calculated in various reference systems. Kinetics of rigid body including Newton's law, work-energy methods and impulse-momentum methods. Measurement of important

properties for dynamic analysis. Introduction to commercial computer S/W for dynamic analysis.

ME301 Numerical Analysis **3:0:3(6)**

This course covers numerical modeling, computers and error analysis, roots of equations, linear algebraic equations, curve fitting, numerical differentiation and integration, ordinary differential equations, and partial differential equations.

ME302 Creative Problem Solving **2:3:3(6)**

Creative solving of engineering problems consists of creative problem recognition, problem definition and analysis, and creative synthesis, etc. Each step is treated in the systematic framework then, students would learn important creative ideation techniques. they would be divided into working groups to experience the creative solving procedures through creative discussion sessions.

ME305 Electronics Laboratory for Mechanical Engineers **2:3:3(6)**

The course "Electronics Laboratory for Mechanical Engineers" provides mechanical engineers with application capabilities utilizing electronics and software technologies. The course is comprised of interdisciplinary topics requiring knowledge from various fields such as mechanics, electronics, software and computer science. The students shall perform a (team based) term project with one of topics related to electronic system design for mechatronics systems, sensor signal conditioning and measurement, digital system design using micro-processor (C-language-based), motor driving for precision control and etc.

Prerequisites are Applied Electronic(MAE307) and C-programming language (or equivalent software programming courses). The C-programming language shall be covered by the course unless the students do no have appropriate level of knowledge for the programming skills.

ME307 Applied Electronics **2:3:3(6)**

Applied Electronics covers the fundamental principles of the electrical engineering and electronics, and provides design and experimental experience for the students to develop the capability to apply the principles to engineering practices. The course includes passive and active circuit elements, analog and digital systems, and electronic instrumentation.

ME311 Heat Transfer **3:0:3(6)**

This course deals with transport phenomena associated with steady and transient heat conductions, forced and free convections, and thermal radiation. Basic heat transfer mechanisms, modeling and formulation of the phenomena, solution procedures, and empirical correlations will be discussed. Also some practical applications will be introduced.

ME312 Energy and Environment **3:0:3(6)**

This course deals with the topics of energy and environment problems. It includes application of thermodynamics like chemical reactions, combustion, phase and chemical equilibrium, thermodynamics of mixture, air conditioning. Also, aerosol fundamentals, particle transport properties, origin and sources of air pollution, emission control technology and air pollutant and global climate, etc. are studied.

ME330 Foundation of Stress Analysis **3:0:3(6)**

This class is designed to help students have the ability to handle the deformation of solids under various field loads analytically and physically. The class will focus on the basic ideas of stress, deformation, energy methods and establishing the governing equations for stress analysis of unsymmetric beam, curved beam, torsion of beam with complex cross section and plates.

ME340 Engineering Design **2:3:3(6)**

This course offers a systematic design methodology encompassing all the design processes from the conceptual design to the embodiment of products. The whole process of product design starting from the problem definition, creation and synthesis of ideas, evaluation of the ideas, and combination of the

generated ideas are included. The course is highlighted by the group project in which students can have practical experiences through the actual product design, manufacturing, operation, and presentation of the results, which requires the synthesis of all the knowledges and techniques acquired through their undergraduate courses.

ME341 Mechanical Component Design **3:0:3(6)**

This course deals first the design methodology and failure criteria based on the deterministic and stochastic analyses. Then the design of mechanical components such as gears, bolts, nuts, shafts, spring, bearings are taught by both the classical safety factor approach method and the reliability or statistical method.

ME342 Mechanism Design **3:0:3(6)**

An introduction to planar linkage kinematics and mechanism design with special emphasis on kinematic synthesis. Topics include displacement and velocity analysis, acceleration analysis, dynamics of mechanisms, cam design, gear trains and kinematic synthesis.

ME351 Mechanical Vibrations **3:0:3(6)**

Designed to give students ability of vibration analysis for dynamic system. especially, Dynamics course (ME250) is needed.

ME360 Modeling and Control of Engineering Systems **3:3:4(6)**

This course deals with modeling and control of engineering systems including mechanical systems and electrical systems. In this course, differently from conventional approach, some practical systems are introduced first for control experience, and then the basic principles are presented for mathematical modeling and feedback control.

ME370 Understanding of Materials and Processing **3:0:3(6)**

This course includes the basic principle of engineering materials and fabrication processes as well as the micro-fabrication processes for the semi-conductor and MEMS processing.

ME371 Advanced Materials Engineering and its Application **3:0:3(6)**

This course aims understanding of basic materials engineering and fabrication/manufacturing process. Basic studies of materials engineering, piezoelectric materials/device, electronic materials/device, polymer materials, and composite materials will be carried out and followed by materials/device fabrication/manufacturing processes study to achieve the course target.

ME400 Capstone Design Ⅰ **1:6:3(6)**

This course helps to provide the students who already have taken engineering design course the ability to apply the design knowledge to practical industrial problems and the creative problem solving ability based on the design methodology and techniques. The design team starts to solve the problem by defining the problem and further tries to think out a new creative design followed by detailed design. The design team then makes a design prototype and evaluate the result. In the whole process, the advisor group of professors and researchers related with the selected topic renders the assistance in order to achieve the design objective.

ME401 Capstone Design Ⅱ **3:0:3(6)**

This course is a continuation of Capstone Design I and based on the designed item the design is further refined to meet the industrial requirements of the industry. The opinions from the industrial side is fed back to design for completion of the design objective. The evaluation is performed in the public presentation.

ME403 Introduction to Naval Architecture and Ocean Engineering **3:0:3(6)**

The general principles of shipbuilding and ocean engineering will be provided to students who did not

majored in this field in his Bachelor degree. Hydrostatics, resistance and propulsion, motion in ocean, structural integrity, rule-based structural design, vibration of ocean systems, offshore structure, drilling principles, under water vehicle will be covered.

ME404 Introduction to Simulation of Medical Procedures 3:1:3(6)

This course introduces the enabling technologies of the medical simulation. The course focuses on the core technologies, universal to broad medical simulation, such as visual interface, haptic interface, systems integration and control. The course also emphasizes the importance of the clinical test and evaluation in the entire life cycle of the medical simulators, ranging from the concept design to the deployment to the teaching hospitals. Example simulators will be used to provide hands-on experience, and to enhance the understanding of the involved theories and practical techniques.

ME405 Design Thinking and Entrepreneurship 2:3:3(6)

For successful launching of new business model, fast implementation of ideation, prototyping, and business model creation is required. This course provides a series of lectures for understanding the concept of open innovation and entrepreneurship. It also provides practical training sessions for students to practice design thinking process, agile development, and new business model creation. The course will provide network to global leaders in design & innovation so that students can have prospective career path understanding.

ME411 Design of Energy Systems 3:0:3(3)

The objective of this course is to study optimum design methods for thermal fluid systems that consist of various components such as pump, compressor, heat exchanger, burner, expansion valve, reactor and distillation tower, etc. First, methods to make mathematical equations to simulate operational performance of each component are presented and solution methods for systems of simulation equations for large system are explained. A number of popular optimization methods are explained in detail and they are used to find optimum configuration of each component that make up the total thermal fluid system.

ME413 Engine Technology 3:0:3(6)

To provide principles of engine technology and the systems of automobile power plants. To introduce the operations of gasoline and diesel reciprocating engines and the analysis of performances followed by the discussions on the future aspects of engine technology concerned with environmental impact.

ME414 Applied superconductivity and Thermal Engineering 3:0:3(6)

This course covers basic principle of superconductivity and advanced refrigeration technology with specific refrigeration components such as compressor, refrigerant, expansion device, and recuperative or regenerative heat exchangers. This course is designed for undergraduate seniors so that they can thoroughly investigate actual applied superconducting equipments and their cooling systems by systematically applying acquired thermo-fluid knowledge. The course will emphasize discussion of practical problems and possible improvement for successful commercialization of superconducting technology.

ME416 Vehicle Dynamics 3:0:3(6)

This course will help students in designing new car suspensions and/or improving car dynamics by learning the influence of the mechanical elements(suspension, steering, brake, tire, etc) to the vehicle dynamic behavior.

ME420 Applied Fluid Mechanics 3:0:3(6)

Brief review of Fluid Mechanics(MAE220); laminar and turbulent internal and external flows; engineering applications; introduction to compressible flows

ME430 Introduction to Reliability in Mechanical Engineering Design 3:0:3(6)

This course treats statistical distributions and methods for evaluation of reliability in mechanical engineering design. The students also learn the general fundamental statistics as a prerequisite knowledge briefly and efficiently. Projects to evaluate reliability are given to the students.

ME431 Introduction to Continuum Mechanics 3:0:3(6)

Basic principles of solid mechanics and fluid mechanics are dealt with in a unified view point on undergraduate level. Vector fields and tensor fields are introduced in cartesian coordinate, and deformation, strain and rate of deformation are studied. Forces, stresses, momentum balance and energy balance are dealt with. Constitutive laws in elastic solid and viscous fluid are studied. Some applications of the theory to solids and fluids are also treated.

ME432 Deformation, Fracture and Strength of Materials 3:0:3(6)

This course will treat the deformation, fracture and strength of materials as the essential knowledge for mechanical design. The dislocation theory and fracture mechanics will be also briefly treated.

ME440 Engineering Design via FEM 3:1:3(6)

This course provides the introduction of FEM, and its application for mechanical engineering design and analysis at the undergraduate level. Basic principles and background of FEM are discussed with the aid of various mechanics examples illustrating the fundamentals of FEM, with the minimum usage of advanced math skill. Typical examples include the coverage of simple elements such as a spring, a truss and a beam via the principle of virtual work, and the extension of this concept to the continuum level. Students will be exposed to intensive use of commercial codes during the lab hours to acquire various techniques for applications of commercial packages for design and analysis.

ME452 Noise Control Engineering 3:0:3(6)

Generation and control of sound/noise will be covered in the course. Fundamental principles that govern sound generation and control are designed to be understood, not by theoretical approach but mainly physical, conceptual means. Class competition and experiment are expected.

ME453 Introduction to Robotics Engineering 3:0:3(6)

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

ME460 Automatic Control 3:3:4(6)

The subject of the course is to study the methods to improve the performance of the mechanical control systems by analyzing their characteristics by transfer function between input and output or by state space approach. contents include analogy between mechanical system and electrical system, modeling of mechanical systems, characteristics of closed loop control system.

ME461 Introduction to Fuel Cell System 3:0:3(6)

This course aims overall understanding of fuel cell systems by studying mechanism, thermodynamics, electrochemical energy conversion and loss, major balance-of-plants such as fuel processors, power conditioning systems, gas moving systems for fuel cells. The course also provides lectures on constructing materials of fuel cells in detail.

ME471 Precision Engineering 3:1:3(6)

Students learn about Principles in design and manufacturing of precision machines and precision components. This course includes lectures and experimental practices on precision machine design and realization of a real products using precision machine tools, measuring machines, and corresponding softwares.

ME475 Mechanical Engineering and Applied Mathematics 3:0:3(6)

This course serves to introduce students to the many mathematical methods by which differential

equations may be solved. A list of the specific topics is provided in the attached Schedule. In covering this material, there should be three overriding objectives: (a) The student should be able to obtain an intelligent working knowledge of a substantial number of useful mathematical methods. (b) The student should be able to connect the mathematical knowledge to physical problems encountered in mechanical engineering. This will lead to an improved understanding of the physical phenomena. (c) A final, yet equally important objective is to develop a positive attitude towards the subject of mathematics. It is incumbent upon the instructor to reveal the vital role that such skills play in students' professional careers and to thereby transmit a sense of excitement for the subject.

ME480 Introduction to Biomedical Optics **3:0:3(6)**

The intention of the course is to introduce basic principles of optics and optical components and to develop a broad skill set for research in biomedical optics including technologies such as lasers, fiber optics, and microscopic optical imaging systems. The lecture series will also introduce current clinical and basic biology challenges that may be addressed by optical solutions.

ME481 Introduction to Electromagnetism & Optics **3:1:3(6)**

This course deals with fundamentals of electromagnetism and optics that are of significant importance in modern mechanical engineering. Emphasis is given to understanding of basic principles and applications of electromagnetic forces, motors, and electromagnetic wave propagation. Optics is also treated with aims of gaining deep comprehension of elementary and system technologies needed to design opto-electro-mechanical systems.

ME484 Structure & Function of Human Body **3:0:3(6)**

This course covers the basics of human anatomy and physiology, so that engineering students become familiar with the body functions. Topics include mechanisms of the cells as well as systems, and some of the ways in which bioengineering, genetic engineering and cell biology are being used to address problems of health and disease based on the principles of physiology.

ME487 Mechanics of cellular movements and mimetics **3:0:3(6)**

This course is designed for mechanical engineering students who are interested in biological motility and its application to engineering and medicine. We will go over the basics of essential cell biology, examples of various cellular movements, and methodology to understand their mechanism. We intend to explore cellular movements and their physical properties, especially for those cells closely related to diseases.

ME488 Introduction to biomedical machine technology **3:0:3(6)**

Basic concepts, tools, and applications in biomedical engineering for mechanical engineers and a survey of the current biomedical machine technology. Gives students a perspective on the relationship between biology, biomedical engineering, and mechanical engineering. Introduces concepts in biomedical engineering and emphasizes the quantitative and integrative nature of biomedical problems including biomedical sensors, bioinstrumentation, physiological modeling, undergraduate level of biomechanics and medical robotics. Brief introduction of anatomy and physiology is provided in the beginning of the course.

ME490 Thesis Study **0:6:3**

Research project is undertaken during the final part of undergraduate study under the supervision of a faculty member. the topic of the project is chosen by the supervisor and the student

ME491 Special Topics in Mechanical Engineering **3:0:3(6)**

this course deal with selected special subjects that it is hard to deal the other course.

ME493 Special Topics in Mechanical Engineering I **1:0:1**

this course deal with selected special subjects that it is hard to deal the other course.

ME494 Special Topics in Mechanical Engineering Ⅱ **2:0:2**

this course deal with selected special subjects that it is hard to deal the other course.

ME495 Individual Study **0:6:1**

Students choose project topics and are supervised by a faculty member.

ME496 Seminar **1:0:1**

Recent advances and related topics in mechanical engineering are presented by invited lecturers.

❒ **Graduate**

ME500 Mathematical Methods in Mechanical Engineering **3:0:3(6)**
Basic mathematical skill, matrix, linear equation, linear space will be covered to study mechanical engineering.

ME502 Introduction to Finite Element Method **3:0:3(6)**
Finite element method to solve a differential equation.

ME505 Measurement Instrumentation **3:0:3(6)**
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.

ME510 Advanced Fluid Mechanics **3:0:3(6)**
Fundamental knowledge on fluid flows is discussed. Derivation of the basic equations and several relevant approximate flow models are introduced. Both inviscid and viscous fluid models are treated.

ME511 Advanced Thermodynamics **3:0:3(6)**
This course deals with the advanced classical thermodynamics for the graduate student. It covers basic concept and postulates, entropy generation and exergy destruction, condition of equilibrium, thermodynamic functions, reversible process and maximum work theorem, Maxwell relations, stability of thermodynamic system, phase transitions and critical phenomena. It also includes chemical thermodynamics and irreversible thermodynamics.

ME512 Advanced Heat Transfer **3:0:3(6)**
The aims of this course are to give the students more concrete understanding of basic ideas of heat transfer and to enable them to design actually applicable devices. Brief introduction to recent research topics will be added at the end. There will be a few homework assignments.

ME513 Advanced Combustion **3:0:3(6)**
This course deals with the calculation of thermochemical equilibrium, chemical kinetics, governing equations for reacting flow, premixed flame, diffusion flame and heterogeneous combustion.

ME514 Multiphase Flow I **3:0:3(6)**
This course deals with various aspects of flow and heat transfer phenomena in multiphase systems, mostly focused on the gas-liquid flow. Basic flow patterns and their background physics, conservation equations, analytical models and experimental results are introduced. In addition, details on the boiling and condensation heat transfer phenomena are discussed. To take this course, basic knowledges on fluid mechanics, thermodynamics, and heat transfer are required

ME515 Cryogenic Engineering **3:0:3(6)**
This course reviews the overall cryogenics fundamentals along with an introduction of the low temperature applications. It will familiarize students with the behavior of materials at low temperature as well as the low-temperature refrigeration system. The entropy transfer concept is introduced and used with the second law in the same way that heat transfer and work transfer are used with the first law. The cryogenic systems of gas separation and gas liquefaction, various types of cryocoolers, cryogenic heat transfer, vacuum technology, and application of superconductivity are main topics.

ME521 Viscous Fluid Flow **3:0:3(6)**
Equations of viscous flow; classical analytical and numerical solutions; flow regimes and approximations; laminar boundary layers - solution methods, and applications; introduction to stability theory; turbulent

boundary layers - mean-flow and Reynolds stress equations, modeling, solution procedures, and applications.

ME525 Turbomachinery **3:0:3(6)**

The objective of this course is first to study the basic principle to analyse performances of axial, centrifugal and regenerative type turbomachines and to carry out optimum design of such turbomachines. In order to establish sound theoretical background, fluid mechanics and thermodynamics are re-examined at their full depth. The analyse and design methods presented in this course can be directly applied to practical industrial fields.

ME526 Introduction to Nanotech Processing **3:0:3(6)**

This course will cover 1) top-down & bottom-up synthesis of nanomaterials such as nano particles, nan owires, nanotubes, and nanobelt of metal, metal oxide, semiconductors and organic materials, 2) various novel properties in optical, electrical, mechanical, chemical and magnetic aspects, and their characterization methods, and finally 3) applications in electronics, renewable energies, and bioengineering fields, and their fundamental physics.

ME530 Advanced Mechanics of Solids **3:0:3(6)**

Deformations and strain measures, and traction vectors and stress measures are introduced, and these are followed by the balance laws (linear momentum balance, angular momentum balance, and energy balance) and the constitutive equations of solid materials. Simple examples of plane problems and St. Venant beams are illustrated for linear theory of elasticity. Furthermore, the reciprocal theorem, the principle of virtual work and the variational principles including the principle of minimum energy are covered.

ME531 Numerical Stress Analysis **3:1:3(6)**

This course offers theoretical bases of the finite element method for linear elastic problems. Various elements are introduced and their merits, defects, and remedies are discussed. Techniques for error analysis, dynamic analysis, and nonlinear analysis are covered. Effective modeling techniques are practiced through engineering problems.

ME533 Fracture Mechanics **3:0:3(6)**

Fundamentals of linear elastic fracture mechanics are introduced, emphasizing singular nature of stress field at the tip. Energy release rate and J integral are studied together with fracture criteria applied to elasto-plastic fracture. Other fracture related topics such as fatigue, creep fracture, corrosion fracture are briefly introduced.

ME534 Fatigue, Fracture and Strength **3:0:3(6)**

This course is designed to give senior or graduate students in engineering the ability to handle fatigue phenomena, methods of life prediction and life enhancement of engineering structures including Electronic Packaging, MEMS and Bio System. Topics include Macro/Micro/Nano Aspects of Fatigue of Metals, Constant Amplitude Fatigue Tests and Data, Notches and Notch strain Analysis, Multiaxial Stresses and Strains, Fatigue from Real Load Histories, Fatigue Crack Propagation, Environmental Effects and Fatigue behavior of Electronics Packaging and MEMS structures

ME536 Mechanics of Plastic Deformation **3:0:3(6)**

The course deals with the fundamental theory of plasticity including the constitutive relations in plastic deformation and the methods of analysis for grasping the deformation behavior. The analytic solution of nonlinear problems in plastic deformation will be discussed and partially, the method of numerical analysis will be introduced.

ME537 Optimal design of Composite Structures **3:0:3(6)**

Introduction of anisotropic solid mechanics based on the classical plate theory (CLT). This course gives an insight on the properties of composite materials and helps to prepare computer programs for the stress and strain analyses. A brief experiment using autoclave vacuum bag molding method is offered to manufacture a sand composite structure.

ME543 Optimal Design **3:1:3(6)**

This course introduces optimization methods and theories. Capability of selecting and applying various algorithms is emphasized. Techniques for formulation and optimization of real problems are covered including discrete optimization, multicriteria optimization, evolutionary programming, and probabilistic optimization.

ME545 Theory of Hydrodynamic Lubrication **3:0:3(6)**

Basic theory of fluid film lubrication and its application in machine design with special emphasis on boundary conditions. Topics include generalized Reynolds equation, THL, EHL, hydrostatic lubrication thrust and journal bearings, turbulent lubrication, oil whirl and oil-whip in journal bearings.

ME547 Knowledge-Based Design System **3:1:3(6)**

Computers are replacing more of human work which require low level of intelligence. This class covers KBDS which can be used for engineering design such as expert system, TRIZ, KMS, ontology, configuration design. By applying basic principles, commercial systems are used for the term project.

ME549 Reliability in Microsystems Packaging **3:1:3(6)**

The importance of reliability in microsystems packaging are treated. Fatigue and creep of solder joints of advanced packaging, fracture mechanics approach for the reliability assessment in microsystem packaging are covered. Fundamental principles of reliability evaluation procedure including Micro-Moire Interferometry are provided. Student will also learn the reliability in microsystems packaging through selected experiments and projects.

ME550 Advanced Dynamics **3:0:3(6)**

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.

ME551 Linear Vibration **3:0:3(6)**

Beginning with linear system theory, principles in advanced dynamics are introduced. Then, single and multiple degree-of-freedom(DOF) systems are covered. Relevance of eigenvalue problems to multiple DOF system analysis is introduced together with some numerical techniques. How to deal with distributed systems such as string, rod, beam, membrane and plate is covered for simple geometries. Numerical approximation techniques for the distributed systems are studied finally.

ME552 Introduction to Acoustics **3:0:3(6)**

Theoretical descriptions that have to do with basic acoustic phenomena; propagation, reflection, transmission, radiation, diffraction, and scattering are to be studied, emphasizing their physical meanings and practical implications. The basic physical quantities in acoustics, such as pressure, impedance, intensity, power, and energy are studied. Human perception on sound also to be introduced, Various scales, including dB and Octave scale, will be introduce and appropriately exercised.

ME553 Robot Dynamics **3:0:3(6)**

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

ME554 Future energy-utilization engineering **3:0:3(6)**

This course covers several different topics related to future energy utilization at 21st century. From solar energy that is human's ultimate energy resource, various recent energy utilization issues will be reviewed including hydrogen energy, Stirling cycle, transcritical cycle, thermoelectrics, and superconductivity. Micro thermal energy conversion system such as micro gas turbine, micro engine, and micro refrigerator will be also discussed for their impact to traditional energy systems. This course will familiarize students with new emerging energy field topics that are driven by environmental protection issues and less dependence of fossil fuels. Advanced thermodynamic cycles and exotic materials will be considered through new energy utilization strategies.

ME561 Linear System Control **3:0:3(6)**

Designed to enable graduate students to make analysis of a given linear system in terms of stability, controllability and observability, and to design a linear controller by using eigenstructure assignment

ME562 Digital System Control **3:0:3(6)**

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.

ME564 Artificial Neural network : Theory and Applications **3:0:3(6)**

This course treats a variety of artificial neural network techniques being currently applied to many difficult-to-solve engineering problems.

ME567 Introduction to Statistical Thermodynamics **3:0:3(6)**

This introductory course deals with principles of theory and application of statistical thermodynamics for students with mechanical engineering major. The course includes principles of kinetic theory and transport phenomena, relation between classical and statistical thermodynamics, and fundamentals of quantum statistical mechanics. Furthermore, applications of statistical thermodynamics to the gas, liquid and solid systems are introduced.

ME570 Advanced Manufacturing Systems **3:0:3(6)**

This course includes the design and automation of the manufacturing system, Rapid Product and micro fabrication technologies.

ME572 Design and Implementation of Nano Actuation System **2:3:3(6)**

Several kinds of positioning systems with the accuracy of nano meter are needed in the field of nano/ bio researches such as semiconductor industry, flat panel display manufacturing, bio manipulation, etc. Lectures for learning principles and design methods of nano precision actuation systems are given during the first half of the semester. During the second half of the semester, nano precision actuation systems using VCM and PZT actuztors, nano precision position feedback sensors and precision motion guide mechanisms are designed and implemented by students in the form of term project.

ME574 Joining Engineering **3:1:3(6)**

This course includes the principle and application of the joining/welding technologies as well as the electronic and MEMS bonding technologies.

ME576 Vehicle Dynamics and Control **3:1:3(6)**

The purpose of the course is to understand the basics of power transmission mechanism and steering, braking and suspension systems as well as mechanics between tire and various road surfaces. Two commercial softwares, Carsim and Simulink, will be taught to enhance the understanding of the dynamics of vehicle with and without various active chassis controls. Also, vehicle dynamics control algorithms are studied to enhance vehicle longitudinal, lateral, vertical, yaw and roll dynamics.

ME582 Introduction to Microfabrication Technology 3:0:3(6)

Based on the fundamental IC process technology, basic MEMS (Micro Electro Mechanical System) technologies such as bulk-micromachining, surface micromachining, and HAR-MEMS process are introduced which are applied for microsensors, microactuators, and micro systems. It also covers recent interdisciplinary subjects such as microfluidics, piezo-MEMS, optical-MEMS, and Bio-MEMS.

ME583 MEMS Design and Experimental Microfabrication 2:3:3(6)

Based on the fundamental MEMS (Micro electro Mechanical System) technology, various microfabrication processes are introduced and processed in the clean room. It covers mask design, photolithography, thin film deposition/etching, bulk microfabrication, and X-ray mask fabrication, which provide the base for independent MEMS research. It also covers recent interdisciplinary subjects such as microfluidics, piezo-MEMS, optical - MEMS, and Bio-MEMS.

ME585 Mechanics and Control of Human Movement 3:0:3(6)

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.

ME587 Optomechatronics 3:0:3(6)

This course will treat a new engineering field termed "optomechatronics" and focus on an integrated approach to effectively combine multi-disciplinary fields (optical/mechatonic). Based on the review of fundamentals optics/mechatronics, the lecture will introduce an in-dept analysis on how such multi-disciplinary fields can be combined to generate fundamental functions generated by the fused technology.

ME589 Applied Optics 3:1:3(6)

This course is designed to provide mechanical engineers with fundamentals of optics by explaining basic phenomena of light with relevant theories. Basics of geometrical optics, wave optics, electromagnetic optics, and quantum optics are introduced in a condensed way of learning with necessary hands-on experiments.

ME591 Random Data: Analysis and Processing 3:1:3(6)

The course introduces fundamental concepts associated with probability, correlation and spectrum. which are required for analysis of random data in the ensemble, time and frequency domain analyses, respectively. Random input and output relationships in linear systems are then described in terms of the correlation and spectral density functions. In particular, techniques using coherence and spectral density functions are demonstrated with various application examples. Data acquisition, processing and qualification issues are also discussed for digital data processing.

ME592 Laser: Principles and Applications 3:0:3(6)

It deals with the principles and applications of various lasers. The principles of laser generation and modification will be introduced. The applications of lasers in different measurement systems and materials processing including electronic fabrication will be treated. Finally laser application in information handling and communication will be explained.

ME600 Mechanical System Design Project 1 0:9:3(6)

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 **0:9:3(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.

ME604 Metrology **2:3:3(6)**

This course deals with the subject of precision dimensional metrology which plays important roles in various fields of modern science and engineering mainly for distance and surface measurements. Principles, fundamentals of optics especially for electromagnet wave interference are explained with emphasis on monochromatic interferometry, white light scanning interferometry, holography, and speckle and moire interferometry.

ME606 Creative Knowledge Creation Process and Application **3:0:3(6)**

The course is designed to learn creative learning methods, computer-aided group ideation and methods for creative knowledge creation toward technology innovation. The course covers the creative learning theories, creative idea generation techniques with related computer-aided creativity methods, knowledge creation model for technology innovation and computer-aided knowledge creation process. Then the learned techniques are applied to practical examples by student groups.

ME607 Computational Linear Algebra **3:1:3(6)**

Numerical techniques for applying linear algebra to mechanical engineering systems are introduced as well as underlying fundamentals for practical applications. Simultaneous linear equations, eigen analysis, iterative methods, and sparse matrix solution method are covered. Through programming practice, computational capability can be enhanced.

ME611 Convective Heat Transfer **3:0:3(6)**

This course deals with various fundamental aspects of convective heat transfer. The mechanism of convective heat transfer and the methods of analytical approach are going to be discussed in depth. The major topics included in this course are the laminar/turbulent heat transfer in internal/external flows and the forced/natural convections. The students are assumed to have taken the introductory courses on fluid mechanics and heat transfer.

ME612 Transport Phenomena **3:0:3(6)**

Discussions are given for a fundamental understanding of mechanism of transport phenomena. A thorough review is conducted for the basic equations in arbitrary continuum and transport processes by molecular motions.

ME613 Computational Fluid Mechanics and Heat Transfer **3:0:3(6)**

The purpose of this course is to familiarize the students with numerical methods of treating differential equations in fluid and thermal engineering fields. In this course, participants get abilities for predicting and analyzing the diverse physical phenomena by using a program. Through various contents of home works and term projects, students can analyze the physical model numerically.

ME615 Nanoscale Heat Transfer **3:0:3(6)**

This course will cover microscopic concepts and methodology in heat transfer at nanoscale, including equilibrium statistics, Boltzmann transport equation, and nanoscale heat conduction and radiation, with applications in contemporary technologies. Lectures will cover fundamental theories and applications, while this course will emphasize a term project to incubate the independent research abilities of students.

ME616 Automobile Technology and Environment **3:0:3(6)**

Principles of engine technology and performance analysis for the environmentally-friendly design and operation are discussed. The key technologies to reduce and treat hazardous exhaust emissions from the automobile systems especially engines are focussed. Advanced engine concepts are introduced to emphasize new powerplant aiming for fuel economy and low emissions to solve both environmental problem and energy resources crisis.

ME617 Advanced Vehicle Control Design **3:0:3(6)**

This course covers the subjects of dealing with the real world problems associated with applying control theories to general mechanical systems that have the unique design limitations in cost and robustness as well as actuator performance. This course introduces signal processing methods and diverse control methods which can be applied to general mechanical control systems. The course is concluded with the case studies of applying the introduced methods to automotive controls.

ME621 Turbulence **3:0:3(6)**

Introduction to turbulence, Governing equation and turbulent flows, statistical description of turbulence, Kinematics and dynamics of homogeneous turbulence, Spectral dynamics of turbulence, Boundary-free shear flows, Wall-bounded shear flows and recent trends in turbulence research.

ME623 Rotating flow **3:0:3(6)**

Flow of fluid in a rotating container is discussed. Models of both inviscid and viscous fluids are dealt with.

ME632 Theory of Viscoelasticity **3:0:3(6)**

Theory of linear viscoelasticity is treated. The extensive discussion on the constitutive behavior of practical viscoelastic materials is followed by the discussion on the various solution techniques for the viscoelastic boundary value problems. Brief treatment on the thermo-viscoelasticity and variational theorems will also be done towards the end of the class.

ME633 Mechanical Behavior of Polymeric and Composite Materials **3:0:3(6)**

In this course various characteristics of the mechanical properties of polymer and composites materials such as deformation, fracture and strength of materials are introduced for the application to engineering design. The evaluation method of mechanical properties are also explained.

ME635 Plastic Analysis and Design of Structures **3:0:3(6)**

Plastic analysis is introduced emphasizing its difference form elastic analysis for strength and design of machines and structures. Plastic behavior of materials is studied based on yield criteria, and limit analysis formulation is derived with variational methods. Beams, Plates, shells and frames are analysed by plastic analysis for design purpose. Complicated structure are also considered for plastic analysis and optimum design.

ME638 Axiomatic Design of Composite Structures **3:0:3(6)**

This course is a continuation of MAE 537. It deals throughly the joining process of composite structures, manufacturing and transport issues in composite materials and impact and fatigue properties of composite structures. After getting acquainted with the axiomatic design theory, the design and fabrication of composite robot structures, machine tools, bearings, rehabilitation of infrastructures and automotive structures which are all the actual research results of the instructor are throughly treated.

ME642 Medical Biomechanics **3:0:3(6)**

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.

ME644 Tribology **3:0:3(6)**

An introduction to tribology which is defined as the science and technology of interacting surfaces in relative motion and of related subjects and practices. Topics include the physics and basic mechanism of friction, wear and lubrication and its application to machine systems.

ME647 STEP for Electronic Commerce **3:1:3(6)**

e-Business is integrated with manufacturing to create new concepts such as B2B, SCM, CRM, CPC, PLM. In this course these new technologies are introduced for the e-business in manufacturing. STEP is an ISO standard which is one of the core technology in this development. Hands-on experience with STEP software tools is provided.

ME651 Rotor Dynamics **3:0:3(6)**

The course introduces simple rotor systems and gradually progresses to the complex systems such as gyroscopic and speed-dependent parameter systems, with a description of all analytical solutions for discrete and continuous rotor systems. It then introduces the concept of lambda matrices, which allows a unified approach to the rotor vibration problems. Some practical issues such as balancing and directional spectral analysis techniques are also treated.

ME653 Mechanical Signatures and System Analysis **3:1:3(6)**

This course is intended to give a profound perspective on the meanings and utilities of mechanical signatures that can be observed in sound and vibration areas. The extraction of useful information from measured typical signal patterns related to the excitation, transmission, reception, and vibration (or radiated sound) will be dealt with, and, more importantly, the consolidation of ideas based on the basic understanding of signatures and underlying dynamics will be emphasized for the practical applications. The final object of this course is to provide students with an understanding of close conceptual relationships between the diagnostics of machine operating condition by using the signature analysis and the design of quiet machines.

ME654 Noise Control **3:0:3(6)**

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.

ME655 Robotics Engineering **3:1:3(6)**

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

ME656 Vehicle NVH **3:1:3(6)**

Fundamental knowledge and method for achieving low-noise and low-vibration vehicle will be studied. The topics on the design, analysis, and countermeasure plan will be covered: Characteristics of sources, human response, radiation, identification of sources and paths, analysis of vibro-acoustics fields, passive/active measure techniques, control elements, etc.

ME661 Optimal Control **3:0:3(6)**

The course will introduce linear quadratic design concepts with LQR and LQG ideas, and provides the bridges to LQG/LTR and introductory Hinfinity synthesis. Numerical solving with Matlab software is

encouraged to illustrate the designmethodologies. Once the LQR concept is established, the tracking and disturbance rejection problem is dealt with linear quadratic sense. For the output feedback system, the measured signal corrupted with noise will be handled with the optimal estimation, and the stochastic regulator problem will be studied as a LQG design with fixed-order compensation. Then the robust-system design issues will be discussed. A term project that applies the optimal control method will be pursued.

ME662 Design of Precision Actuation System 3:0:3(6)

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.

ME674 Optical Imaging System Design 3:0:3(6)

The contents of this course is composed of two parts. Part 1 deals mainly with the fundamentals of optical system such as basic theory of wave optics and geometrical optics, performance factors such as aberration, resolution, contrast etc., working principle and characteristics of several optical components, systematic design process and computer aided design. Part 2 deals with the configuration, design and signal processing of actual optical systems for 2D and 3D imaging, variations of system configuration, enhancement of system performances such as resolution contrast and imaging speed. During the second half of this course, a term project will be carried out in a teamwork. Every Team will propose and design an optical system in the term project and the performance of the proposed optical system will be approved by simulation.

ME683 Human Robot Interaction: Haptics 3:0:3(6)

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.

ME692 Wave Propagation 3:0:3(6)

Waves in a string, bar, plate and shell are theoretically, but emphasizing their physical and practical meaning to be conveyed. Surface waves and waves in solid are also to be discussed.

ME711 Radiation Heat Transfer 3:0:3(6)

Starting with fundamental concepts, the most advanced topics are treated in depth. It is aimed that the students will be able to understand and analyze fundamentals of boilers, industrial furnaces, space heat transfer, super-insulators and etc.

ME722 Computational Turbulence Modeling 3:0:3(6)

Introduction and hands-on experience on the selected experimental methods commonly used in the high temperature thermal engineering. Basic electronics and computer interfacing, photography, lens and mirrors, Schieren, interferometry, image processing, high speed image, radiation detectors, monochromators, lame emission spectroscopy, flame scanning, flame extinction, flame probe measurements.

ME722 Computational Turbulence Modeling 3:0:3(6)

The purpose of this course is to study logical methods to develop computational turbulence models at

various closure levels. Modeling philosophy is exemplified in detail for mixing length model and two-equation model. The model behavior is investigated with a number of ideal benchmark flows and the effects of model constants are discussed. Recent methods of LES and DNS are also presented.

ME724 Stratified Flow **3:0:3(6)**

Physical descriptions of stratified flow are dealt with. flow models of inviscid and viscous fluids are discussed.

ME731 Nonlinear Computational Solid Mechanics **3:0:3(6)**

Computational approach to general nonlinear solid mechanics is treated via finite element analysis with emphasis on finite strain plasticity. In addition to static nonlinear problems, some theories and techniques on nonlinear dynamic analysis are treated.

ME732 Reliability in Strength Design **3:0:3(6)**

Reliability is one of the most important issues in strength design of machines and mechanical structures. Statistical characteristics of various material strengths and statistical properties of service loads are studied, and design concepts related to reliability in automobiles, railways and aircraft are introduced in this course.

ME752 Structure-borne Sound **3:0:3(6)**

Sound is radiated from the vibration of structures or transmitted through the structures that enclose the whole machine. In this course, generation conditions and characteristics of sound from vibrating structures are studied. The following topics are studied in a successive manner: propagation and damping characteristics of waves in solids, how the structure receives the external excitation, how the sound is radiated from structures that received an amount of excitation power, and how the sound is transmitted through an enclosing structure of a machine and a partition separating two connected cavities.

ME761 Nonlinear System Control **3:0:3(6)**

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.

ME762 Adaptive Control System **3:0:3(6)**

This course deals with the adaptive control method such as model based adaptive control (MRAC), STR, LMFAC and the various constant measurement methods based on the least square method. Theoretical analysis involves the adoption theory of Lyapunov, Popov, robustness analysis, Stochastic adaptive control and variable measurements by Kalmana filter.

ME771 Analysis and Design of Metal Forming Processes **3:1:3(6)**

The basic analysis techniques required for design of the manufacturing processes such as extrusion, rolling, forming, deep drawing, etc. will be introduced. the fundamentals of such design procedures will be handled by case studies and experiments.

ME781 Molecular Simulations and Nanomechanics **3:0:3(6)**

This course provides an in-depth coverage of the molecular dynamics simulation, and various examples are treated in conjunction with its applications for nanomechanics, which deals with the mechanics of nanoscale systems. The lecture will start with a brief introduction to statistical mechanics at a level appropriate for mechanical engineering students, and a short coverage will be given to the straightforward treatment of the microcanonical ensembles. Then non-Hamiltonian dynamics is discussed to treat the use of thermostats or barostats in MD simulation, and various ensembles will be covered. We emphasize that MD simulation leads to the characterization of various mechanical systems at the atomistic level and its usefulness for calculating mechanical properties of materials and systems.

Other topics may include free energy calculation, non-equilibrium molecular dynamics, Ab Initio Molecular dynamics, coarse graining and time scale problems, and rare events etc. Lastly various examples of nanomechanics will be explored from the application aspect of molecular dynamics and the related techniques.

ME800 Special topics in Mechanical Engineering 3:0:3(6)
This lecture is designed to deal with the selected theory and application in mechanical engineering part. The specific topics will be announced before the semester begins.

ME801 Special topics in Mechanical Engineering Ⅰ 1:0:1
This course deal with selected special subjects that it is hard to deal the other course.

ME802 Special topics in Mechanical EngineeringⅡ 2:0:2
This course deal with selected special subjects that it is hard to deal the other course.

ME810 Special topics in Thermal & Fluid Engineering 3:0:3(6)
This lecture is designed to deal with the selected theory and application in thermal and fluid engineering part. The specific topics will be announced before the semester begins.

ME830 Special topics in Design Engineering 3:0:3(6)
This lecture is designed to deal with the selected theory and application in design engineering part. The specific topics will be announced before the semester begins.

ME850 Special topics in Dynamics and Control 3:0:3(6)|
This lecture is designed to deal with the selected theory and application in dynamics and control part. The specific topics will be announced before the semester begins.

ME870 Special Topics in Production Engineering 3:0:3(6)
This lecture is designed to deal with the selected theory and application in production engineering part. The specific topics will be announced before the semester begins.

ME960 M.S. Thesis

ME964 Individual Research M.S. 0:3:1
When an individual work is required for the topics which are not covered by the current M.S. curriculum in the field of mechanical engineering, an individual research will be carried out and the research results should be summarized by the students and be submitted to the supervisor for its evaluation.

ME966 Seminar M.S. Program 1:0:1
The recent advances and related topics in mechanical engineering are presented by invited lectures. Also, special projects and thesis study given to students are presented and discussed. This course proceeds with group that is composed of several students guided by advisor professor.

ME967 Individual Research M.S. 0:6:2
When an individual work is required for the topics which are not covered by the current M.S. curriculum in the field of mechanical engineering, an individual research will be carried out and the research results should be summarized by the students and be submitted to the supervisor for its evaluation.

ME980 Ph. D. Thesis

ME985 Individual Research Ph.D. 0:3:1
When an individual work is required for the topics which are not covered by the current Ph.D. curriculum in the field of mechanical engineering, an individual research will be carried out and the

research results should be summarized by the students and be submitted to the supervisor for its evaluation.

ME986 Seminar Ph. D. Program **1:0:1**

The recent advances and related topics in mechanical engineering are presented by invited lectures. Also, special projects and thesis study given to students are presented and discussed. This course proceeds with group that is composed of several students guided by advisor professor.