Descriptions of Courses

❑ Undergraduate

MAE106 Human and Machine

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.

MAE200 Basic Mechanical Practice: Modelling & Realization

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.

MAE205 Mechanical Engineering Laboratory

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.

MAE206 Machine System Automation

The object of this course is to provide the undergraduate students good understanding and interest about the machine system. In the first half of the course, Lectures about the pneumatic elements/systems and PLC system/programming are given and in the second half, actual automated machine systems are designed, built, and actuated by the students.

MAE208 New Design and Experience in Mechanical Systems

The course provides fundamental principle and basic experiment experience of the new areas of mechanical engineering such as rapid prototyping, MEMS (Micro Electro Mechanical System), and fuel cell. It also gives opportunity of new academic experience of experiments and base for applications to other mechanical fields.

MAE211 Thermodynamics

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.

MAE221 Fluid Mechanics

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.

MAE231 Mechanics of Materials

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

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.

MAE301 Numerical Analysis

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.

MAE302 Creative Problem Solving

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.

MAE305 Mechanical Engineering Lab II

Various equipments will be applied to explain the essential experiments in mechanical engineering. Measurement and processing of data will be carried out using PC. 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.

MAE307 Applied Electronics

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.

MAE311 Heat Transfer

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.

MAE312 Energy and Environment

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.

MAE320 Applied Fluid Mechanics

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

MAE330 Foundation of Stress Analysis

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.

MAE340 Engineering Design
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.

MAE341 Mechanical Component Design
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.

MAE342 Mechanism Design
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.

MAE351 Mechanical Vibrations
Designed to give students ability of vibration analysis for dynamic system. especially, Dynamics course (MAE250) is needed.

MAE360 Modeling and Control of Engineering Systems
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.

MAE370 Understanding of Materials and Processing
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.

MAE371 Advanced Materials Engineering and its Application
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.

MAE400 Capstone Design I
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.

MAE401 Capstone Design II

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.

MAE403 Application of Computer Graphics

Computer graphics on the Internet will be introduced with hands on experience. It covers VRML(virtual reality modeling language), X3D(Extensible 3D, XML for 3D), Java3D, MPEG-4, and also commercial systems Cortona, EON Studio, Cult3D. Term project will be a group project where you should build a cyber world on the Web.

MAE411 Design of Energy Systems

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.

MAE413 Engine Technology

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.

MAE414 Applied superconductivity and Thermal Engineering

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.

MAE430 Introduction to Reliability in Mechanical Engineering Design

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.

MAE431 Introduction to Continuum Mechanics

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.

MAE432 Deformation, Fracture and Strength of Materials

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.

MAE440 Engineering Design via FEM

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.

MAE441 CAE Systems and Applications

Through introduction of various software systems in use in industry and research sectors, the state of the art in practical engineering analysis and design are reviewed. Also introduced are basic principles and limitations of the software tools in the areas of solid mechanics, thermal fluid and dynamical systems. Methods included are finite difference, finite element, mesh free, algebraic differential equation, optimization and other simulation techniques. A literature survey of CAE application cases must be presented. A CAE project of student's interest area must be performed and presented.

MAE452 Noise Control Engineering

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.

MAE453 Introduction to Robotics Engineering

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

MAE460 Automatic Control

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.

MAE461 Introduction to Fuel Cell System

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.

MAE471 Precision Engineering

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.

MAE474 CAD/CAM(Computer Aided Design and Manufacturing)

This course concentrates on learning about definitions, history, development directions, principles and applications of CAD/CAM and improving applicability by pursuing a sequence of exercises and a term project.

MAE481 Introduction to Electromagnetism & Optics
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.

MAE483 Introduction to Statistical Thermodynamics
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.

MAE484 Structure & Function of Human Body
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.

MAE490 Thesis Study
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

MAE491 Special Topics in Mechanical Engineering
this course deal with selected special subjects that it is hard to deal the other course.

MAE495 Individual Study
Students choose project topics and are supervised by a faculty member.

MAE496 Seminar
Recent advances and related topics in mechanical engineering are presented by invited lecturers.

❏ Graduate

MAE500 Mathematical Methods in Mechanical Engineering
Basic mathematical skill, matrix, linear equation, linear space will be covered to study mechanical engineering.

MAE502 Introduction to Finite Element Method
Finite element method to solve a differential equation.

MAE505 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.

MAE510 Advanced Fluid Mechanics
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.

MAE511 Advanced Thermodynamics
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.

MAE512 Advanced Heat Transfer
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.

MAE513 Advanced Combustion
This course deals with the calculation of thermochemical equilibrium, chemical kinetics, governing equations for reacting flow, premixed flame, diffusion flame and heterogeneous combustion.

MAE514 Multiphase Flow I
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

MAE515 Cryogenic engineering
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.

MAE521 Viscous Fluid Flow
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.

MAE525 Turbomachinery
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.

MAE530 Advanced Mechanics of Solids
Fundamentals of solids mechanics are treated from the continuum mechanics view, and the content of the undergraduate solid mechanics is extended and generalized to the graduated level.

MAE531 Numerical Stress Analysis

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.

MAE533 Fracture Mechanics

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.

MAE534 Fatigue, Fracture and Strength

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

MAE535 Experimental Stress Analysis

In this course the experimental methods and associated techniques ,through which mechanical properties of engineering materials such as stress, strain, strength and fracture toughness can be evaluated, are introduced and explained with experiments.

MAE536 Mechanics of Plastic Deformation

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.

MAE537 Optimal design of Composite Structures

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.

MAE543 Optimal Design

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.

MAE545 Theory of Hydrodynamic Lubrication

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.

MAE546 Vehicle Dynamics

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.

MAE547 Knowledge-Based Design System
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.

MAE548 Feature-Based Modeling
The geometric kernel is the engine of a CAD/CAM system. The basic concepts of a geometric modeler, parametric design, and feature modeling will be introduced. The group term project allows you to develop s geometric modeler. The history-based parametrics is also introduced.

MAE549 Reliability in Microsystems Packaging
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.

MAE550 Advanced Dynamics
Kinematics of two and three dimensional motions of rigid bodies are started with as well as particle motions. An efficient and systematic method for derivation of equations of motion of such a system is studied based on Kane's approach. The most fundamental law, i.e., Newton's 2nd law and other advanced dynamic(Hamilton and Lagrange) equations are covered as well for comparison purpose.

MAE551 Linear Vibration
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.

MAE552 Introduction to Acoustics
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.

MAE553 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.

MA554 Future energy-utilization engineering
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.

MAE561 Linear System Control
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

MAE562 Digital System Control
this course introduces the basic concept of discrete time control in the time domain and the state space. the major results of control theory such as stability, observability, controllability, optimality, etc. will be reviewed for the discrete time case. some other contents included in this course are sampling theory, discrete modeling of the systems, discretization of continuous system, microprocessor applications, etc.

MAE563 Microprocessor Application
Designed to give graduate students the ability to understand basic principles of microprocessors and their applications in modern product designs. Prerequisites by topics: basic electrical circuits, computer languages.

MAE564 Artificial Neural network : Theory and Applications
This course treats a variety of artificial neural network techniques being currently applied to many difficult-to-solve engineering problems.

MAE570 Advanced Manufacturing Systems
This course includes the design and automation of the manufacturing system, Rapid Product and micro fabrication technologies.
MAE574 Joining Engineering
This course includes the principle and application of the joining/welding technologies as well as the electronic and MEMS bonding technologies.

MAE582 Introduction to Microfabrication Technology
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.

MAE583 MEMS Design and Experimental Microfabrication
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.

MAE585 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.

MAE586 Biomechanical modeling and simulation of tissue behavior

The course provides an overview of musculoskeletal anatomy, the mechanical properties, behavior of biological tissues. Topics include structure and function relationships in tissues and organs; application of stress and strain analysis to biological tissues; introduction to modeling viscoelastic tissues; digital human anatomy modeling; real time simulation of a tissue behavior.

MAE587 Optomechatronics

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.

MAE588 Fuel Cell System Design and Numerical Analysis

This course aims understanding and acquirement about numerical analysis and optimization technique of thermal and fluid system to design fuel cell system. The course also includes system analysis and design technique including balance-of-plant to obtain efficient fuel cell system.

MAE591 Random Data: Analysis and Processing

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.

MAE592 Laser: Principles and Applications

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.

MAE604 Metrology

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.

MAE605 Boundary Element Method

Mathematical background of boundary integral equations is introduced with basic tools. Boundary element discretization is explained using 2-D potential problems. Various manipulations for boundary conditions, body forces, initial strain, etc. are studied with programming techniques. Various application areas such as acoustics, transient problems, and shape design sensitivity analysis will be discussed. Students are required to submit term project reports and present one of them.

MAE606 Creative Knowledge Creation Process and Application

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.

MAE607 Computational Linear Algebra
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.

MAE611 Convective Heat Transfer
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.

MAE612 Transport Phenomena
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.

MAE613 Computational Fluid Mechanics and Heat Transfer
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.

MAE616 Automobile Technology and Environment
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.

MAE621 Turbulence
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.

MAE623 Rotating flow
Flow of fluid in a rotating container is discussed. Models of both inviscid and viscous fluids are dealt with.

MAE631 Analytical Solid Mechanics
Advanced theories on solid mechanics, including mathematical formulations of a large deformations and some constitutive theories, are covered in their course.

MAE632 Theory of Viscoelasticity
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.

MAE633 Mechanical Behavior of Polymeric and Composite Materials
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.

MAE634 Intelligent Structures and Components
In this course smart structure or intelligent system, which can respond properly to the given environments such as applied load and dynamic forces, will be introduced.
The basic theory and design method will be explained with associated components of smart structures such as sensors, actuators and controllers.

MAE635 Plastic Analysis and Design of Structures
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.

MAE638 Axiomatic Design of Composite Structures
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.

MAE642 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.

MAE643 Theory of Mechanisms
The kinematical behavior of mechanical system is dealt with in depth including 3 dimensional space and systematic computer aided design methodology will be introduced based on graph theory for type and dimensional synthesis.

MAE644 Tribology
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.

MAE647 STEP for Electronic Commerce
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.

MAE651 Rotor Dynamics
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.

MAE652 Computational Vibration Analysis

This course covers various computational methods for structural vibration analysis. The topics include discrete and continuous modeling, qualitative behavior of Eigenvalue Problems, efficient algorithms for eigen properties calculation, forced response analysis, finite element analysis for vibration, ···etc. Also the new emerging techniques such as component mode synthesis, eigen property sensitivities, structural dynamics modifications will be studied. At the end the course, all the students will have an experience to do a term project related to computational vibration analysis.

MAE653 Mechanical Signatures and System Analysis

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.

MAE654 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.

MAE655 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.

MAE661 Optimal control

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.

MAE662 Design of Precision Actuation System

This course is designed for graduate students. In the beginning, Design principles are introduced. Next, several structure design techniques such as kinematic design, flexture mechanism design, guide mechanism

design, etc. are studied. Then error analysis/compensation and uncertainty analysis are 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.

MAE683 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.

MAE692 Wave Propagation
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.

MAE711 Radiation Heat Transfer
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.

MAE712 Experimental Methods in High Temperature Thermal Engineering
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.

MAE714 Multiphase Flow II
This course deals with various advanced topics on multiphase flow such as the interfacial behavior, two-phase flow instabilities, critical flows, phase separation at branches, microchannel flows and some other current topics of interest. Basic knowledges on two-phase flow phenomena are required to take this course. The students taking this course are strongly encouraged to participate in class discussions actively on each topic.

MAE722 Computational Turbulence Modeling
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.

MAE724 Stratified flow
Physical descriptions of stratified flow are dealt with. flow models of inviscid and viscous fluids are discussed.

MAE731 Nonlinear Computational Mechanics of Solid
Material and geometric nonlinear mechanics of solids is covered from the viewpoint of the computational methodology, with the main focus being given to finite element and the related computational methods.

MAE732 Reliability in Strength Design

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.

MAE734 Analytical Fracture Mechanics

Various conservation integrals in regard to fracture mechanics are studied beginning from NÖther's theorem and Eshelby's energy momentum tensor. Their application to recent fracture mechanics is studied emphasizing the recent developments in interfacial fracture mechanics(isotropic bimaterials, anisotropic bimaterials, etc).

MAE738 Design of Light Sandwich Structures

The weight reduction of mechanical, aerospace structures and infra-structures not only save material usage but also reduce the energy consumption during their operations. This course offers the methods for the design of composite faces and cores of sandwich structures. Also the adhesive bonding between the faces and cores of sandwich structures are thoroughly treated. Then the design, characterization and manufacturing method of composite structures are treated in detail.

MAE741 Advanced Optimal Design

Introduce theories and methods of distributed parameter optimization, shape design sensitivity analysis for mechanical and structural systems. Formulations of recent topics are then introduced together with typical algorithms, implementations, and applications: reliability-based design optimization, robust design, Pareto optimality, and topology optimal design.

MAE752 Structure-borne Sound

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.

MAE761 Nonlinear System Control

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

MAE771 Analysis and Design of Metal Forming Processes

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.

MAE800 Special topics in Mechanical Engineering

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.

MAE810 Special topics in Thermal & Fluid Engineering

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.

MAE830 Special topics in Design Engineering
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.

MAE850 Special topics in Dynamics and Control
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.

MAE870 Special Topics in Production Engineering
is 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.

MAE960 M.S. Thesis

MAE966 Seminar (M.S. Program)
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.

MAE980 Ph. D. Thesis

MAE986 Seminar (Ph. D. Program)
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.