Department of Mechanical Engineering

Mechanical Engineering [MEN]

Mechanical Engineering deals with numerous systems and has a variety of important applications such as automobiles, aircraft, ships, home appliances, electronic devices, power plants and so on. The mechanical systems and the fundamental science and technology of mechanical engineering have made dramatic advances and high impacts on the global economies and the standard of living. In the track of mechanical engineering, students are educated and trained to learn the underlying principles of mechanical engineering and to apply the knowledge to real-world examples and case studies hands-on. Disciplines include thermodynamics, fluid mechanics, solid mechanics, dynamics, machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics, tribology and so on.

Credit Requirement

Program	Total Credits required	Course Credit	Research Credit
Master's Program	at least 28 credits	at least 18 credits	at least 10 credits
Doctoral Program	at least 60 credits	at least 18 credits	at least 42 credits
Combined Master's-Doctoral Program	at least 60 credits	at least 30 credits	at least 30 credits

Curriculum

▶ Mechanical Engineering [MEN]

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Required	MEN590	Research	The Seminars	세미나	1-1-0		
	MEN690		Master's Research	석사논문연구	Value of credit		
	MEN890		Doctoral Research	박사논문연구	Value of credit		
Elective	MEN500	Lecture	Advanced Numerical Methods	수치해석특론	3-3-0		
	MEN501		Continuum Mechanics	연속체역학	3-3-0		
	MEN502		Advanced Mechanical Engineering Analysis	기계공학해석특론	3-3-0		
	MEN510		Advanced Thermodynamics	열역학특론	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	MEN511	Lecture	Advanced Heat Transfer	열전달특론	3-3-0		
	MEN512		Advanced Combustion	연소특론	3-3-0		O
	MEN513		Convection Heat Transfer	대류열전달	3-3-0	MEN310	
	MEN520		Advanced Fluid Mechanics	유체역학특론	3-3-0		
	MEN521		Microfluidics and Nanofluidics	미세유체역학	3-3-0		O
	MEN522		Computational Thermofluid Engineering	전산열유체공학	3-3-0		
	MEN523		Advanced Therofluid Measurement	열유동 계측특론	3-3-0		O
	MEN524		Aerosol Technology	에어로졸특론	3-3-0		O
	MEN525		Turbulence	난류특론	3-3-0		
	MEN530		Advanced Solid Mechanics	고체역학특론	3-3-0		
	MEN531		Finite Element Method	유한요소법특론	3-3-0		O
	MEN532		Mechanics of Composites	복합재역학특론	3-3-0	MEN432	
	MEN535		Computational Nanomechanics	전산나노역학	3-3-0		O
	MEN551		Computer-Aided Design	전산기원용설계	3-3-0		O
	MEN552		Manufacturing Processes and Systems	생산공정 및 시스템	3-3-0		
	MEN553		Manufacturing and Process Engineering	생산공학특론	3-3-0		
	MEN554		Machine Tool Analysis and Control	공작기계 해석 및 제어	3-3-0		
	MEN556		Laser Material Interaction and Processing I	레이저 재료 상호작용 및 가공 I	3-3-0		O
	MEN557		Polymer and Composite Manufacturing	고분자 및 복합재료 제조공정	3-3-0		
	MEN558		Advanced MEMS	MEMS특론	3-3-0		O
	MEN559		Bio MEMS	바이오MEMS	3-3-0		O
	MEN560		Unconventional Nanomanufacturing	비전통적 나노가공기술	3-3-0		O
	MEN570		Advanced Dynamics	동역학특론	3-3-0		
	MEN571		Robotics	로봇공학	3-3-0		O
	MEN572		Nonlinear Systems	비선형 시스템	3-3-0		
	MEN573		Advanced Control Systems I	고급제어 I	3-3-0		O
	MEN574		Real-Time Applications of Control Systems	제어 시스템 구현	3-3-0		O
	MEN575		Electromechanical dynamics	전자기기 동력학	3-3-0		O
	MEN656		Laser Material Interaction and Processing II	레이저 재료 상호작용 및 가공 II	3-3-0		O
	MEN732		Failure Analysis and Design for Reliability	파괴해석과 신뢰성 설계	3-3-0		

Course is	Course No.	Classification	Course Title	Course Title (Kor.)	Cred.-Lect.-Exp.	Pre-requisite	Convergence
Elective	MEN733	Lecture	Mechanics of Polymer Solids and Fluids	고분자역학	3-3-0		
	MEN734		Scanning Probe Microscopy	주사 탐침 현미경	3-3-0		
	MEN735		Bioinspired Technology	생체모사공학	3-3-0		O
	MEN755		Net Shape Manufacturing	소성가공	3-3-0		
	MEN772		Advanced Analytic Kinematics	해석기구학특론	3-3-0		
	MEN773		Advanced Control Systems II	고급제어 II	3-3-0		O
	MEN774		System Identification and Adaptive Control	시스템식별 및 적응제어	3-3-0		O
	MEN791		Special Topic Ⅰ	기계공학특론 Ⅰ	3-3-0		
	MEN792		Special Topic Ⅱ	기계공학특론 Ⅱ	3-3-0		
	MEN793		Special Topic Ⅲ	기계공학특론 Ⅲ	3-3-0		
	MEN794		Special Topic Ⅳ	기계공학특론 Ⅳ	3-3-0		
	MEN795		Special Topic Ⅴ	기계공학특론 Ⅴ	3-3-0		
	MEN796		Special Topic Ⅵ	기계공학특론 Ⅵ	3-3-0		
	MEN797		Special Topic Ⅶ	기계공학특론 Ⅶ	3-3-0		
	MEN796		Special Topic Ⅷ	기계공학특론 Ⅷ	3-1-4		
	MEN797		Special Topic Ⅸ	기계공학특론 Ⅸ	3-1-4		

Description

MEN500 Advanced Numerical Methods (수치해석특론)

This course focuses on the modern computational and mathematical techniques needed for solving engineering problems. In this course, numerical methods for solving sets of nonlinear algebraic equations, ordinary differential equations, and differential-algebraic (DAE) systems are covered. The use of these techniques will be demonstrated.

MEN501 Continuum Mechanics (연속체역학)

This is a core course for graduate study in Mechanical Engineering. This course provides knowledge of the fundamental, comprehensive concepts of the mechanics of continua, including tensors, rigorous definitions of stress and strain, laws of thermodynamics for a continuum, and fundamentals of behavior of solids and fluids.

MEN502 Advanced Mechanical Engineering Analysis (기계공학해석특론)

This course introduces application of mathematical methods to the description and analysis of systems in mechanical engineering.

MEN510 Advanced Thermodynamics (열역학특론)

This course reviews the fundamentals of macroscopic thermodynamics and then introduces statistical thermodynamics that describes thermodynamic phenomena and analyzes them from the standpoint of microscopic quantities. Topics include the basic principles of thermodynamics, classical kinetic theory, the fundamentals of quantum mechanics, Bose-Einstein and Fermi-Dirac quantum statistics, partition functions, and the Schrodinger equation for the modes of translation, rotation, vibration, etc. Various application methods enabling the estimation of thermodynamic properties will be studied.

MEN511 Advanced Heat Transfer (열전달특론)

This course reviews the fundamentals of heat transfer and then studies more profound convective heat transfer and radiation. It further discusses the cooling system using nanofluids, applications of heat transfer to biomedical devices, micro-/nano heat transfer system, and semiconductor cooling using electrokinetics and mass transfer.

MEN512 Advanced Combustion (연소특론)

This course covers chemical thermodynamics, chemical kinetics, oxidation mechanism of fuels, environment combustion such as NOx and soot, and conservation equations for reacting flows. Based on the basic knowledge, the characteristics of premixed flames, nonpremixed flames, and ignition/extinction of flames, and turbulent combustion and modeling will be discussed.

MEN513 Convection Heat Transfer (대류열전달)

The objectives of this course is to gain in-depth knowledge of a heat transfer mode accompanied by fluid motion, namely, the convection heat transfer. In addition, this course aims to obtain deeper understanding of analytic approaches and approximate procedures for closed-form solutions. The contents of this course include analysis of laminar/turbulent forced/natural convection phenomena and velocity/temperature distribution in boundary layers; external and internal flows; and analytic/numerical methods for predicting the heat transfer coefficients for various related engineering systems.

MEN520 Advanced Fluid Mechanics (유체역학특론)

This course teaches mathematical and physical foundations of fluid mechanics. The first part of the course is a brief review of tensor analysis, followed by rigorous derivations of continuity equation, momentum equation, and energy equation for Newtonian fluids. After that, topics such as low Reynolds number flows, laminar flows, turbulent flows, boundary layers, vorticity dynamics, and irrotational flows are covered with practical examples.

MEN521 Microfluidics and Nanofluidics (미세유체역학)

Microfluidics and nanofluidics is the study of how fluids behave at the micro and even nano scale. This course is aimed primarily at graduate students in science and engineering who have some background in or are interested in learning more about microfluidics. In this course not only do we study the basic physics such as low Reynolds number fluid mechanics, electrokinetics and heat and

mass transfer, but we also discuss how physical phenomena are implemented in microfluidic devices. We further discuss microfabrication techniques necessary for building bio-compatible microfluidic devices and organic, biological samples such as DNA, protein and cells.

MEN522 Computational Thermofluid Engineering (전산열유체공학)

This course introduces basic methods to solve fluid mechanics problems, heat flow problems, and coupled fluid-flow & heat-flow problems using the techniques of Computational Fluid Dynamics (CFD). A focus is placed on incompressible fluid flows and accompanying heat flows, and students will deepen their understanding by writing CFD programs through homework assignments and course projects.

MEN523 Advanced Thermofluid Measurement (열유동계측특론)

In this course, we are able to widen and deepen our understanding of thermofluid measurement methods based on the fundamentals of heat transfer and fluid mechanics. We will learn how to measure flow fields and temperature fields by using the principles of PIV (particle image velocimetry) and a hotwire method. We will also learn how to use LabVIEW and other measurement equipment.

MEN524 Aerosol Technology (에어로졸특론)

The objective of this class is to understand fundamental knowledge of gasborne particles (aerosols) and their physical/chemical/thermal/optical/electric properties. Also, the generation, collection, and measurement of aerosols will be covered along with the basic concepts and applications of biological aerosols (bioaerosols).

MEN525 Turbulence (난류특론)

In this class, we will study a basic turbulence theory for understanding of viscous, incompressible turbulent flow. The topics include: 1) Introduction to turbulence, 2) Governing equations and turbulent flows, 3) Statistical description of turbulence, 4) Kinematics and dynamics of homogeneous turbulence, 5) Spectral dynamics of turbulence, 6) Boundary-free shear flows, 7) Wall-bounded shear flows and 8) New research trends in wall turbulence.

MEN530 Advanced Solid Mechanics (고체역학특론)

In this course, we will gain the ability to solve general solid mechanics problems, by defining the stress and strain based on the tensor theory and by understanding the governing equations such as equilibrium, constitutive, and compatibility equations between stress and strain. In addition, the special problems and their theoretical solutions in solid mechanics will be introduced.

MEN531 Finite Element Method (유한요소법특론)

In this course, the theory and formulation behind finite element method will be introduced. To gain hands-on experience of finite element method, practical applications in engineering will be covered.

MEN532 Mechanics of Composites (복합재역학특론)

This course will introduce students to the fundamental mechanics of composite (more than one phase) solids. The topics will include effective stiffness properties of composites, constitutive description of laminated plates, and laminated plate theory. Other advanced topics such as nonlinear theory of generally laminated plates, governing equations in the Von Karman sense, laminated plates with moderately large deflections, post-buckling and nonlinear vibration of laminated plates, and failure theories and experimental results for laminates will also be discussed.

MEN535 Computational Nanomechanics (전산나노역학)

In this course, classical molecular dynamics and quantum simulation methods will be discussed in detail as general computational tools to explore nanomaterials and nanosystems. For this, basic characteristics of nanomaterials and numerical algorithmswill be introduced. Through a numerical project, we will broaden our understanding of nanomaterials and nanomechanics.

MEN551 Computer-Aided Design (전산기원용설계)

This course introduces fundamentals of CAD, including geometric and solid modeling, parametric representations, features, and human-machine interactions. Applications to design, analysis, and manufacturing will be covered.

MEN552 Manufacturing Processes and Systems (생산공정 및 시스템)

To provide graduate students with an integrated treatment of the analysis of traditional and non-traditional manufacturing processes, their selection and planning, within an economic framework, this course will cover materials processing analysis and selection, manufacturing systems design and economic analysis.

MEN553 Manufacturing and Process Engineering (생산공학특론)

This course introduces the basic design techniques of various manufacturing tools, including cutting tools, forming dies, inspection gages, jigs and fixtures. The course also covers the fundamental planning principles and techniques of manufacturing processes, including routing planning and operations design. Through term projects performed in teams, students integrate the fundamental principles into solving practical manufacturing process problems within an economic framework.

MEN554 Machine Tool Analysis and Control (공작기계 해석 및 제어)

To develop an advanced understanding of machining processes in the context of machinery, mechanics, dynamics, monitoring techniques, and control strategies. In this course, mechanics and dynamics of machining, machine tool components and structures, sensors and controls of machine tools, machine process planning and optimization will be covered.

MEN556 Laser Material Interaction and Processing I (레이저 재료 상호작용 및 가공 I)

In this course, students learn the basic principles of lasers and various interaction mechanisms in

laser material interaction. Based on this basic knowledge, students will also learn various areas of laser materials processing. Topics include laser interaction with various materials (such as metals, semiconductors, dielectrics, and biological tissues), laser cutting, laser drilling, laser welding, laser heat treatment, laser cladding, and laser micromachining.

MEN557 Polymer and Composite Manufacturing (고분자 및 복합재료 제조공정)

This course is designed to expose graduate students to a variety of processing methods for polymers and polymer-matrix composites. Polymer processing methods include injection molding, extrusion, fiber spinning, filament winding, etc. for both thermoplastic and thermosetting polymers. Topics in polymer-matrix composites include not only traditional fiber-reinforced composites, but also design, manufacturing, characterization, and application of such cutting-edge material systems as high-temperature, multifunctional composites and nanocomposites. Integral components to this course are modeling- and simulation-based material property prediction and cost (or affordability) analysis, which will enable students to design and manufacture polymers and polymer-matrix composites within an economic framework.

MEN558 Advanced MEMS (MEMS특론)

MEMS/NEMS technologies are adopted in a variety of mechanical, electronic devices and sensors. This course introduces principles of conventional microfabrication techniques and, working principles and design rules for MEMS device fabrication. It also includes applications and some case studies of MEMS devices. MEMS is a typical interdisciplinary research area so that the application of this course is expected to be extended to research areas such as electronic engineering, biochemistry, chemistry, physics, medical science and etc.

MEN559 Bio MEMS (바이오 MEMS)

This course organizes its contents along a bottom-up biological pathway made by nature so that we will discuss the impacts made by innovative bioMEMS/NEMS technologies on the development of biology: genomics, proteomics, metabolomics, signaling pathway modulation, and tissue and artificial organ engineering. Not only we will learn/review general biology and bioMEMS but also we will discuss what engineers can build for biologists/scientists and what they require us to develop.

MEN560 Unconventional Nanomanufacturing (비전통적나노가공기술)

This course introduces unconventional nano/microscale manufacturing and fabrication techniques as well as their unique applications. Fundamental ideas, technical trends and interesting recent works will be covered.

MEN570 Advanced Dynamics (동역학특론)

This course will cover the following: kinematics and kinetics of plane and three-dimensional motion, Coriolis acceleration, general methods of linear and angular momentum, central force motion, gyrodynamics, generalized coordinates, and Lagrange's equations. Prerequisite skills are a basic knowledge of fundamental calculus and differential equations

MEN571 Robotics (로봇공학)

This course aims at teaching students basic mathematical and computational tools for modeling and analysis of robotic systems. Students will learn to identify, model, analyze, design, and simulate robotic systems, including their kinematics, dynamic responses, and control. In addition, students will gain an understanding of sensory and mechanical components integrated within a robotic system.

MEN572 Advanced Control Systems II (고급제어 I)

Input-output and state space representation of linear time-invariant continuous and discrete time dynamic systems. Design and analysis of single and multi-variable feedback control systems in time and frequency domain. Controllability, observability, and stability. System modelling and identification. State observer. Linear Quadratic Optimal Control.

MEN573 Real-Time Applications of Control Systems (제어 시스템 구현)

Mini and micro computers, operating in real time, have become ubiquitous components in engineering systems. The purpose of this course is to build competence in the engineering use of such systems through lectures stressing small computer structure, programming, and output/input operation, and through laboratory work with mini and micro computer systems.

MEN574 Nonlinear Systems (비선형 시스템)

Introduction to nonlinear phenomena: multiple equilibria, limit cycles, bifurcations, complex dynamical behavior. Planar dynamical systems, analysis using phase plane technique. Describing fuction. Input-output analyssi and stablitity. Lyapunov stability theory. feedback linearization.

MEN575 Electromechanical dynamics (전자기기 동력학)

Electromagneic theory, Lumped electromechanical elements, Circuit theory, Energy conversion, Riotating machines, Lumped-parameter electromechanical dynamics

MEN590 The Seminars (세미나)

The purpose of this course is to extend knowledge of the state-of-the-art R&D in real scientific fields; and to get indirect experience by contacting experts in various fields. Students and professors can exchange their own ideas and information to reach creative and fine-tuned achievements through the Seminars.

MEN656 Laser Material Interaction and Processing II (레이저 재료 상호작용 및 가공 II)

In this course, students learn the basic principles of lasers and various interaction mechanisms in laser material interaction. Based on this basic knowledge, students will also learn various areas of laser materials processing. Topics include laser interaction with various materials (such as metals, semiconductors, dielectrics, and biological tissues), laser cutting, laser drilling, laser welding, laser heat treatment, laser cladding, and laser micromachining.

MEN690 Master's Research (석사논문연구)

This course is related to the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.

MEN732 Failure Analysis and Design for Reliability (파괴해석과 신뢰성 설계)

This course introduces various mathematical and experimental techniques employed for failure analysis, provides knowledge of fundamental physics of material and structure failure, and provide the knowledge needed to apply these concepts to design for reliability. Through term projects, students integrate fundamental principles and techniques.

MEN733 Mechanics of Polymer Solids and Fluids (고분자역학)

This course deals with continuum mechanics of solids and fluids, mechanics of deformation of anisotropic polymers, anisotropy and critical failures, such as yield, fracture and fatigue, non-Newtonian viscous and viscoelastic behavior of polymer fluids. Students will study the mechanics-based foundations for developing structure-property relations in polymer and learn constitutive models.

MEN734 Scanning Probe Microscopy (주사탐침현미경)

In variety of research areas, SPMs (scanning probe microscopes) work as a powerful research tool capable of providing spatially/temporally resolved diverse surface properties through the tip apex or micro/nanoelectrode integrated near/at the tip apex. This course provides fundamentals of diverse kinds of SPMs and applications of specific SPMs in details.

MEN735 Bioinspired Technology (생체모사공학)

Elucidating the underlying principles of natural systems will enable us to develop more reliable, efficient and environment-friendly biomimetic systems with advanced performances. This course is focused on the study of mechanics of macro/micro/nanoscale components in nature using fundamental principles of mechanical engineering, and apply them to the development of bio-inspired functional structures, devices and systems with innovative multiscale manufacturing techniques.

MEN755 Net Shape Manufacturing (소성가공)

This course focuses on the manufacturing of discrete parts to net or near net dimensions by stamping, forging, machining, and tube hydroforming.

MEN772 Advanced Analytic Kinematics (해석기구학특론)

A machine is a combination of resistant bodies so arranged to transmit motion and forces. The device to transmit forces or modify motion is called a mechanism. The basic element of any machinery consists of various mechanisms, in the most cases of 2-D(dimensional) mechanisms. In this advanced lecture series, 3-D linkage mechanisms will be dealt with analytical methods. Understanding analyses methods of a mechanism is important procedure in designing a machine.

And due to dynamic nature of the mechanism, the analysis or synthesis will be carried via computer, and it is known as one of the major application areas of CAD(Computer Aided Design). However, an analytical method, which produces the exact solution, belongs to the research domain. The Directional Cosine Matrix Method developed by the instructor will be discussed.

MEN773 Advanced Control Systems II (고급제어 II)

Stochastic State Estimation (Kalman filter), Linear Quadratic Gaussian Problem, Loop Transfer Recovery, Feedforward/preview control, Repetitive Control, Analysis and synthesis techniques for multi-input (MIMO) control systems.

MEN774 System Identification and Adaptive Control (시스템식별 및 적응제어)

Probability Theory, Parametric Time-domain Methods, Non-Parametric Frequency-Domain Methods, Stability Analysis of Adaptive Systems, Model Reference Adaptive Control, Self-tuning Regulators, Advanced topics on System Identification and Adaptive Control.

MEN791~797 Special Topics in Mechanical Engineering I ~Ⅸ (기계공학 특론 I ~Ⅸ)

In this course, special topics in mechanical engineering are discussed based on the knowledge of the principles of solid mechanics, dynamics, thermodynamics, fluid mechanics, heat transfer, manufacturing process, system design, and power system engineering. Topics may include machine design, advanced materials processing, laser-assisted manufacturing, micro/nano machining, MEMS, biomedical products, controls and mechatronics, acoustics and dynamics, tribology, heat problems in microchips and light emitting diodes, wind power, blood flow, micro/nanofluidics, heat exchanger design in nuclear power plants, and combustion in engines.

MEN890 Doctoral Research (박사논문연구)

This course is related to the students graduate thesis and dissertation. As such, students should be actively working in a laboratory setting and gaining experience through hands-on experimentation.