2017 철강대학원
교과과정 안내

포항공과대학교

철강대학원

1. 설립목적

사회의 균형 잡힌 발전을 위해서는 미래를 지향하는 첨단 분야 산업기술 발전을 추구함과 동시에 근간을 담당하는 공업기반 산업기술의 발전 또한 필수적이다. 철강 산업은 사회발전의 원동력을 구축하는 공업기반산업으로써 기계, 전자, 조선, 자동차 등 제조업과 건설업에 기반소재를 공급하여 생산과 부가가치를 증대시키는 전후방 관련효과가 매우 큰 산업이며, 국제경쟁력 확보의 근간을 이루는 산업이다. 전 세계의 철강 산업은 철강 제조업계와 철강 수요업계를 중심으로 중흥의 시대를 맞이하고 있으나, 규모의 대형화에 따른 업체 간 경쟁심화 및 선진 철강사 간 기술보호 확산 등 철강 산업의 환경변화에 능동적으로 대응하기 위해서는 신기술 개발 및 창의적 연구능력을 갖춘 글로벌 철강전문 인력의 양성이 절실히 요구되고 있다. 따라서 철강대학원은 21세기 지식기반 경제시대에 철강 산업의 미래를 이끌어 나갈 철강기술 전문 인력을 지속적으로 양성하여 공급함으로써, 국내 철강 산업의 발전과 국가경제발전에 기여하기 위해 설립되었다.

2. 연혁

철강대학원은 1995년 개원 이래 산업체 근무경력이 있는 엔지니어 및 학사과정을 마친 인력을 대상으로 철강 산업에 종사할 의지가 확고한 학생을 선발하여 교육을 실시해 왔으나, 철강 산업 환경 변화에 따라 특수대학원 체제에서의 인력양성의 한계를 극복하기 위해 2005년 개원 10주년을 맞이하여 전문대학원으로 체제를 전환하였다. 이에 더하여, 대학의 철강역량 강화를 위한 위원회가 구성되어 우수 철강인력양성과 철강전문 연구기반 구축을 두 축으로 하는 중장기 철강혁신프로그램을 수립하였다.

3. 교육방향

포항공과대학교 철강대학원은 철강에 관한 교육, 기술개발 및 연구 분야에서 명실상부한 세계 최고를 지향하는 전문대학원이다. 세계 최고 수준의 철강전문 기술연구 인력의 양성을 목표로, 연구와 교육의 질, 국제적 소양, 리더십과 비즈니스 마인드를 강화 할 수 있는 국제적으로 개방된 새로운 프로그램을 구성하여, 국제경쟁력을 보유한 교육과 연구 환경을 제공하고 있다. 학생은 각자가 원하는 세부전공분야에 따라 가장 적합한 전임교원을 지도교수로 정하고 모든 교육과 연구 활동을 지도교수의 지도하에 수행한다. 철강대학원의 교육은 교과목 이수, 논문연구, 실용 연구 참여로 구성되며 철강대학원 및 타 대학원에서 개설되는 학과목을 선택하여 이수 할 수 있고, 논문연구 시에는 본인의 관심분야를 중심으로 지도교수와 상의 하에 연구 과제를 정하여 국내외 철강회사 및 관련분야 전문가들의 지도를 받으며 실무적 감각 및 연구의 실용감각을 익힐 기회를 제공받는다. 교수진과 학생의 구성이 국제화됨에 따라 강의, 토론, 행정 등 제반 업무를 영어를 공용어로 하여 진행 한다.

4. 설치과정

가. 설치과정 및 과정별 이수학점

설치과정	교과학점	연구학점	총 이수학점
석사과정	18	10	28
박사과정	12	20	32
통합과정	30	30	60

※ 교과학점 이수 시 유의사항: 대학원 교과학점 과목은 다음 과목들을 포함한다.
1) 철강대학원 교과목
2) 타 학과 대학원 교과목 (지도교수와 상의 하에 한 학기 6학점 이수가능)
3) 학부 400단위 교과목 (6학점까지 인정)

※ 연구학점 이수 시 유의사항: 대학원 연구학점 과목은 다음 과목들을 포함한다. 석사과정은 세미나 과목을 4학기 이상 이수해야 한다.
1) 석·박사 논문연구
2) 철강대학원 세미나
3) 외국어과목

나. 과정별 졸업 요건

[석사과정]
1) 졸업에 필요한 교과(18) 및 연구학점(10)을 이수해야 한다.
2) 석사학위논문심사: 지도교수 포함 3인의 심사위원을 선정하여 심사한다.

[박사 및 통합과정]
1) 박사과정 수료를 위해서는 졸업에 필요한 교과(12) 및 연구학점(20)을 이수해야 한다.
2) 박사자격시험: 학과에서 정한 소정의 박사자격시험에 합격해야 한다.
3) 논문 게재: 학과에서 정한 국제학술지(SCI)에 1편 이상의 논문을 게재해야 한다.
4) 박사학위논문심사: 지도교수 포함 5인의 심사위원을 선정하여 심사한다. 심사위원 5명 중 최소한 1명은 과외에서 선정하며, 철강대학원 교수가 과반수 이상 이어야 한다.

[박사자격시험 요강]

응시 요건	박사 및 통합 3학기 이상 재학 응시 전 교과학점 12학점 이수 (입학 후 2학기 내 모두 이수할 것을 권장함) 평균평점 3.0/4.3 이상
시기	박사 및 통합과정 3~4학기 중 수시
소요시간	2시간 내외
심사위원	박사과정: 박사학위 논문 심사위원 구성과 동일 통합과정: 지도교수 포함 3인의 심사위원 선정, 철강대학원 전임교수가 과반수 이상 이어야 함
합격기준 및 판정	심사위원의 심의에 따라 합격 또는 불합격으로 판정함
재시험	첫 시험에 불합격한 자는 입학 후 4학기 이내 1회에 한해 재시험 기회부여

※ 학위논문 작성 방법은 포항공과대학교 요람 [대학원학위논문작성지침]을 참고.

5. 개설과목

가. 개설교과목

학수번호	교과목명	강의-실습(실험)-학점
GIFT501	Seminars in Ferrous Metallurgy Ⅰ	1-0-1
GIFT502	Seminars in Ferrous Metallurgy Ⅱ	1-0-1
GIFT503	Seminars in Ferrous MetallurgyⅢ	1-0-1
GIFT504	Seminars in Ferrous MetallurgyⅣ	1-0-1
GIFT50201	Masters Thesis Research	1-0-1
GIFT50203	Masters Thesis Research	3-0-3
GIFT50206	Masters Thesis Research	6-0-6
GIFT50301	Doctoral Dissertation Research	1-0-1
GIFT50303	Doctoral Dissertation Research	3-0-3
GIFT50305	Doctoral Dissertation Research	5-0-5
GIFT508	Technical Writing	3-0-1
GIFT50801	English Composition-Intermediate	3-0-1
GIFT50802	English Composition-Advanced	3-0-1
GIFT50803	Presentation Skill	3-0-1
GIFT50804	Audio-Visual English	3-0-1
GIFT50805	Topic Discussion - Intermediate	3-0-1
GIFT50806	Topic Discussion - Advanced	3-0-1
GIFT50807	Clinic	3-0-1
GIFT509	Technical Korean	3-0-1
GIFT600	Metallurgical Thermodynamics	3-0-3
GIFT601	Metallurgical Reaction kinetics & mech.	3-0-3
GIFT602	Principles of Steelmaking Process	3-0-3
GIFT603	Principles of Ironmaking Process	3-0-3
GIFT604	Convective Heat and Mass Transfer	3-0-3
GIFT605	Texture and Related Phenomena	3-0-3
GIFT606	Computational Thermodynamics	3-0-3
GIFT610	Solid State Physics for Ferrous Technology	3-0-3
GIFT611	Transmission Electron Microscopy	3-0-3
GIFT6111	TEM Laboratory	1-0-1
GIFT612	Understanding of Modern Steel Products	3-0-3
GIFT613	Theory of Dislocations	3-0-3
GIFT618	Magnetic Materials and Application	3-0-3
GIFT619	Special Topics on Physical Metallurgy	1-0-1
GIFT620	Phase Transformation in Steels	3-0-3
GIFT621	Modeling of Phase Transformations in Steels	3-0-3
GIFT624	Crystallography	3-0-3

학수번호	교과목명	강의-실습(실험)-학점
GIFT629	Special Topics on Computational Metallurgy	3-0-3
GIFT630	Mechanical Properties of Ferrous Alloys	3-0-3
GIFT631	Special Topics for Ferrous Technology	3-0-3
GIFT632	Advanced X-ray Diffraction Analysis	3-0-3
GIFT634	Welding and Joining	3-0-3
GIFT640	Thermal and Fluid Engineering	3-0-3
GIFT642	Special Steels	3-0-3
GIFT651	Special Topics on Mechanical Metallurgy	1-0-1
GIFT653	Plasticity and Forming	3-0-3
GIFT654	Brittle and Ductile Fracture	3-0-3
GIFT655	FEM for Crystalline Solid	3-0-3
GIFT657	Continuum Mechanics	3-0-3
GIFT658	Experimental Mechanics	3-0-3
GIFT659	Metal Failure and Its Prevention	3-0-3
GIFT660	Structure & Properties of Metallic Alloys	3-0-3
GIFT661	Electrical Steels	3-0-3
GIFT669	Selected Topics on the Mechanical Properties of Steel	3-0-3
GIFT671	Corrosion Science and Engineering	3-0-3
GIFT672	Stainless Steels	3-0-3
GIFT673	High Temperature Oxidation and Coatings	3-0-3
GIFT674	Introduction to Organic Coatings	3-0-3
GIFT675	Protective Coatings for Steel Corrosion	3-0-3
GIFT678	Special Topics on Chemical Metallurgy	3-0-3
GIFT680	Advanced Control Theory and Applications	3-0-3
GIFT681	Robotics	3-0-3
GIFT689	Special Topics in Control and Automation	3-0-3
GIFT694	Structure and Properties of Slags	3-0-3
GIFT700	Introduction to Metallurgical Engineering	3-0-3
GIFT701	Characterization and Microanalysis	3-0-3
GIFT702	Solidification	3-0-3
GIFT703	Steel Production Technology	3-0-3

나. 교과과정 및 교과내용

GIFT501, 502, 503, 504 Seminars in Ferrous Metallurgy

The purpose of this course is to give students the opportunity to obtain information about important issues and recent progress in the steel industry from invited specialists in each field. This course is required of all full-time PhD candidates in each semester for which they are registered.

GIFT50201~50203 Masters Thesis Research

These courses are required to perform research projects for the M.S. degree under the supervision of a faculty advisor.

GIFT50301~50305 Doctoral Dissertation Research

These courses are required to perform PhD research projects under the supervision of a faculty advisor.

GIFT508~50807 Technical English Courses

Technical English courses are designed for student's writings or prepared to write major research paper, a thesis or a dissertation. The English courses will highlight characteristics of effective writing in the various section of research paper and also will help students create dynamic presentations with the emphasis their unscripted oral skills while presenting and when responding to questions.

GIFT509 Technical Korean

Improvement of overall Korean ability with a focus on productive skills of enhancement.

GIFT600 Metallurgical Thermodynamics

The objective of the course is to understand basic principles of thermodynamics, and to apply the principles in various phenomena relevant to ferrous metallurgy. The laws of thermodynamics will be applied to gas, liquid, solid systems with special emphasis on Iron & Steelmaking systems (gas, metal, slag, inclusions, refractory, etc.). Basic solution theory, energy requirements, relations between Gibbs energy and phase equilibrium & phase stability will be examined. Thermodynamics of surfaces and interfaces and the bases of electrochemistry will also be introduced. The students are to be prepared for a meaningful use of computational thermodynamics software in real Iron & Steelmaking situations after the course.

GIFT601 Metallurgical Reaction Kinetics & mech.

This course deals with reaction mechanisms and kinetics of metallurgical systems and discussion on reaction processes. In particular, this course addresses the important rate controlling processes in high-temperature reactions, including gas phase mass transfer, free vaporization, liquid phase mass transfer and heat transfer. On completion of this course, students are expected to be confident of dealing with heterogeneous reactions occurring in steelmaking, refining, casting, reheating and hot rolling.

GIFT602 Principles of Steelmaking Process

Understand the causes and countermeasures for defects in continuously cast slabs/blooms during steelmaking and continuous casting process, and the effects of defects on final products.

GIFT603 Principles of Ironmaking Process

The course will be directed towards systematically understanding the underlying principles of ironmaking by focusing on the basic interactions between various components and phases. The class will also drive the students to adapt themselves to the real ironmaking processes by making them understanding the ways and means of increasing blast furnace productivity, which depends upon the fuel efficiency and flow of materials and gases through the dry and wet zones of the furnace. The course is also required to be aware of the important treatment of raw iron ores and coals, which is one of the hot issues in the field of ironmaking since the efficient pretreatment of raw materials dominantly occupies the competitiveness of the entire steel production process.

GIFT604 Convective Heat and Mass Transfer

This course is intended to provide students with the fundamentals and tools needed to model, analyze and solve the various kinds of problems involving “flow induced transport”phenomena in Iron & Steel making process. Starts from discussions about basic concepts and equations in convection, this course will cover analytic solution methods, boundary layer theory, empirical solutions and numerical simulations. On completion of this course, students are expected to be confident of how to solve the transport and fluids problems analytically and numerically.

GIFT605 Texture and Related Phenomena

Texture, or preferred orientation, is a fundamental phenomenon resulting from the microstructure evolution that takes place during various processes including casting, thin film fabrication, and thermo mechanical processing of materials. A strong texture developed in material results in anisotropy in properties of the material. Therefore, ‘texture and related phenomena’ has been a subject of teaching and research because of its technological importance and scientific interest. The object of this course is to teach texture and related phenomena focusing on steels and related materials.

GIFT606 Computational Thermodynamics

This course will provide 1) an introduction on recent advances on computational thermodynamics, 2) solid back ground on the principles lying behind the computational thermodynamics. Students are expected to use such computations in their own researches after the course is completed. Among various possible applications using the computational thermodynamics, topics related to metallurgy will be discussed.

GIFT610 Solid State Physics for Ferrous Technology

The objective of this course is modern understanding of materials relies upon atomic-scale description of material properties. This course will provide fundamental Concepts in solid state physics from quantum mechanical point of view. Starting with chemical bonding in solids, crystallography, electronic theory, lattice dynamics, and phase transition are covered.

GIFT611 Transmission Electron Microscopy

The purpose of this course is to introduce students the basic principles of transmission electron microscopy. The first part of lecture will cover the basics of electron optics, structure of TEM, and principles of electron diffraction. Geometry of electron diffraction and its application to the structure analysis will be emphasized. In the second part, theory of image contrast in TEM will be presented. Kinematical and dynamical theory of diffraction contrast will be discussed with examples of crystalline defects such as dislocations, stacking faults and inclusions. The principles of other commonly used methods will also be presented. These include Convergent beam electron diffraction (CBED), High Resolution TEM (HRTEM), Energy Dispersive Spectroscopy (EDS), Electron Energy Loss Spectroscopy (EELS). This course offers only the basic principles of TEM.

GIFT6111 TEM Laboratory

Transmission electron microscope (TEM) is a powerful tool for the analysis on the sub-micron or nanometer scale microstructure. However, actual operation of TEM is so complicated that beginner needs to understand the structure of TEM and the analytical technique. In this course, the actual skill for TEM operation and the explanation of TEM structure will be treated for the beginner of TEM operation.

GIFT612 Understanding of Modern Steel Products

The course “Understanding Modern Steel Products”gives the students an in depth introduction to the physical metallurgy of steels. The approach is application-oriented, emphasizing engineering properties of steels and the requirements specific to the use of steel in the transport, energy, consumer products, and constructional industries. In The introductory lectures, essential concepts of strengthening mechanisms in crystal plasticity are reviewed. In the first part of the course, the following topics are covered: Formable Low Carbon Steels, High Strength Low Alloy Steels, Multiphase Steels, Conventional CMn Steels, Specialty Steels, Stainless Steels and Engineering Steels. In the second part of the course, the making, shaping and processing of steel in state-of-the-art production facilities is discussed in detail. The course also introduces the main SAE/ASTM/AISI, EN, JIS and ISO standardization schemes for steel grades.

GIFT613 Theory of Dislocations

This course will cover the basic theory of dislocation including fundamental concept of dislocation, basic linear elasticity, stress-strain fields and associated self-energies of dislocation. Dislocation in various crystal structures and its interactions with other defect structures will also be given. The essential object of this course is to provide the students with the relationship between strengthening mechanism and dislocation motion in the crystalline structures in a comprehensive way.

GIFT618 Magnetic Materials and Application

This course introduces basic concepts of electromagnetism related to magnetic materials, and a variety of other topics, including Kinds of Magnetism, Magnetic Phenomena, and Commercial Magnetic Materials. The process of producing electrical steels is also reviewed.

GIFT620 Phase Transformation in Steels

This course will give an overview on the principles of phase transformation of steels and related issues, which is very essential to understand the diverse and versatile properties of modern steel products. The objective of this course is to provide the students with the fundamentals on equilibrium and non-equilibrium phase transformation in ferrous alloy, which contains basic solution thermodynamics, diffusion, and reconstructive and displacive transformation behavior in steel. Strengthening mechanism available for ferrous alloys and the concept of microstructure control by heat treatment and thermo-mechanical treatment will also be given.

GIFT621 Modeling of Phase Transformations in Steels

The objective of the course is to provide principal concepts of phase transformations and related phenomena through theoretical models and numerical practice. Several numerical practices working with simple codes will be assigned after introduction to the fundamental ideas of models.

GIFT624 Crystallography

The course is intended for candidates who have a zero knowledge of crystallography, who by the end of the course should be able to deal both with the elements of modern crystallography and mathematical aspects dealing with diffraction, interfaces, texture, phase transformations and deformations.

GIFT630 Mechanical Properties of Ferrous Alloys

The objective of this course is to introduce students to the in-depth concept of mechanics of materials. The introductory part of the course includes the review of continuum mechanics such as vector and tensor analysis, stress, strain and general principles. In addition, advanced topics on modern constitutive theory such as mathematical description of elasticity and plasticity, their application to finite element method, crystal-based plasticity will be introduced.

GIFT632 Advanced X-ray Diffraction Analysis

This course explores quantitative x-ray analysis using kinematic x-ray diffraction theory, including thermal-diffuse scattering, distortion and mosaic size, stacking disorder, local ordering and clustering, small angle scattering, liquid and amorphous solids. The course also covers EXAFS and x-ray topography using dynamic x-ray diffraction theory.

GIFT634 Welding and Joining

To provide principal understanding of various welding and joining technologies commonly applied for steel products. Both conventional and new joining processes including their applications are to be introduced. Weld ability of C-Mn steels and stainless steels are also to be discussed with various issues in welds.

GIFT640 Thermal and Fluid Engineering

This is an interdisciplinary course that examines thermal processes and fluid flow. The course considers the thermal behavior of gas, liquid, and solid phases from the mechanical point of view, including statistical mechanics. Topics include basic concepts of thermodynamics and analysis of fluid flow phenomena using vector-tensor calculus. Some boundary value problems of heat conduction are examined. Convection transport phenomena in both the laminar and turbulent

regimes are presented. This course emphasizes the significances of the equations and their application to real systems, and presents quick methods to estimate key indices to choose paths of detailed analysis.

GIFT642 Special Steels

This course presents alloy design and physical metallurgy, processing technology, and characterization of corrosion-resistant stainless steels, heat-resistant high-temperature steels, die steels, and various specialty steels.

GIFT653 Plasticity and Forming

This course is an introduction to plasticity and its application to metal forming. The course will emphasize the continuum description of plasticity, which is more suitable for the analysis of forming processes compared to micro-scale descriptions. The course will start with an introduction of mathematical tools, vectors and tensors, necessary to understand the continuum concepts of stress and strain. The relationship between stress and strain, or constitutive behavior, will be established first for a linear elastic solid. The non linear relationship between these quantities for a plastic solid will be covered in detail through the classical flow theory of plasticity. The Concepts of isotropic and anisotropic behavior will be introduced. Material properties relevant to forming analyzes will be described together with relevant micro-structural features and deformation conditions. The notion of formability will be discussed in connection with plastic instability and fracture phenomena. The flow theory of plasticity will be applied to the analysis of bulk and sheet forming operations through the upper bound and other methods.
A few specific processes will be studied in more details: Rolling, extrusion and forging for bulk forming; Drawing, stretching and stamping for sheet forming.

GIFT654 Brittle and Ductile Fracture

This course is an introduction to the fracture analysis of brittle and ductile solids. Metals deformed at low temperature are usually fragile and remain essentially elastic even when a crack propagates. Ductile materials, such as many metals deformed at room temperature or most metals deformed a high temperatures are ductile. In steels, there is a transition temperature under which the material is brittle and above which it is ductile. In brittle metals, cracks propagate as a result of the separation of inter-atomic planes, or cleavage, while in a ductile materials, the mechanism of fracture occurs by an increasing degradation of the material, damage, during plastic deformation. Ductile fracture is a sequence of three distinct phenomena: 1) Nucleation of micro-voids by decohesion from the matrix of in-homogeneity such as second phases and inclusions, or by cracking of these particles; 2) Growth of micro- voids due to plastic flow in the matrix and; 3) Coalescence of voids through the processes of micro-localization of ligaments linking neighboring voids. Fracture occurs in a part either during forming or during service. During forming, fracture is ductile and occurs after damage accumulation while, in service, it can be either brittle or ductile. In service, fracture occurs by cracks nucleation, due to material cycling fatigue, and crack propagation through the structure. In this class, the different types and mechanisms of fracture will be described. Fracture occurring in forming will be analyzed based on theories of void nucleation, growth and coalescence, and using constitutive descriptions of plasticity for materials containing small amounts of porosity. Fracture in service will be discussed after an introduction to fracture mechanics where stress and strain fields around a crack tip are analyzed. Stress, strain

and energy criteria for crack propagation will be introduced and concepts such as fracture toughness and fatigue crack growth will be discussed.

GIFT655 FEM for Crystalline Solid

This course provides fundamentals of finite element methods for solids. The class covers the finite element formulations of linear static analysis, displacement-based finite element procedures, formulation of nonlinear static finite element methods, and elementary theory of single and polycrystalline solids. Especially, this course will discuss how to implement the constitutive material models into the finite element methods. Every student is required to be involved in a term project by which he or she can obtain hands-on experience in solving problems by using a commercial FE software (through the user material subroutines).

GIFT657 Continuum Mechanics

The purpose of the course is to study the equations that describe material deformation and the forces required to achieve it. Continuum mechanics does not assume that materials are linearly elastic or that their geometry is simple and their internal deformations are known. Continuum mechanics allows deformations to be arbitrarily large and material responses to be nonlinear and dissipative. This introductory continuum mechanics course does not cover specific material models in much depth; instead, it covers general principles, thermodynamics that apply to all material models, and simpler linear and nonlinear constitutive models.

GIFT658 Experimental Mechanics

This course is an introduction to methods to characterize the mechanical behavior of solids. Concepts include principles of materials science and engineering relevant to the interpretation of structure-property relationships, contact and non-contact methods in experimental solid mechanics. For contact methods, presentation will begin with traditional strain gauges and extensometer, then proceed to nano-indentation and atomic force microscopy. For non-contact methods, the background knowledge in optics and wave phenomena will be introduced to describe a number of techniques. In particular, the principles of digital image correlations, photo-acoustics and X-ray diffraction will be established. Specific applications of the different techniques to the characterization of the behavior of metallic materials will be introduced. This will include high rate and impact property determination, and residual stress analysis.

GIFT659 Metal Failure and its Prevention

This course will give an overview of fracture, fatigue and creep processes of metallic alloys, which take most part of failure in structural parts. Lecture will focus on the detailed mechanisms responsible for the failure, mechanical and microstructural factors and its prevention methods. Recent hot topics related with such failure will also be discussed.

GIFT660 Structure & Properties of Metallic Alloys

This course examines application of science and engineering principles to the design, selection, and performance of engineering alloys (including steel, Al, Mg, Ti, Ni alloys). Topics include alloy classes, design, effect of alloying elements, relation to processing variables, and structure-property relationships.

GIFT661 Electrical Steels

This course introduces fundamental theory of electric and magnetic fields applied to materials. It discusses microstructure and electrical/magnetic properties of grain-oriented silicon steels. This course explains the effect of hot rolling on microstructure and properties of silicon steels. It addresses the effect of cold rolling on secondary re-crystallization in silicon steels and high temperature deformation of silicon steels. The course covers the structure and texture of electrical steels. Examples of various kinds of electrical steels will be cited together with current and future electrical steel technology.

GIFT669 Selected Topics on the Mechanical Properties of Steel

This course reviews the state of knowledge of the mechanical properties of ferritic and austenitic steel grades and their implications for the automotive, constructional and engineering industries, which are the most important areas of engineering in which steels are used. The course also introduces students to the most recent insights into strengthening processes in standard steels and advanced high-strength steels. The course emphasizes practical applications of the available theories to steels.

GIFT671 Corrosion Science and Engineering

The basic theory of electrochemistry will be studied since it controls the main reaction mechanism of aqueous corrosion. Various forms of corrosion will be discussed in terms of reaction between the material and environment. Corrosion prevention methods will be introduced depending on the specific corrosion system, including alloy design, organic painting, and cathodic protection.

GIFT672 Stainless Steels

This course begins with an overview of general features of stainless steels. It briefly introduces students to the melting and refining processes of stainless steel production together with alloy design concepts. The class will be directed towards understanding important surface treatment, microstructure- and corrosion control of stainless steels, integrating process-controlling factors and micro-structural features and mechanical properties of stainless steels. Examples of several grades of stainless steels will be discussed together with current and future technology of stainless steel production.

GIFT673 High Temperature Oxidation and Coatings

In this class, the principle of high temperature oxidation mechanism is discussed for various engineering materials including steels. The basic concepts of alloy design for high temperature applications are introduced. Various engineering practices for protective coating technologies are reviewed.

GIFT674 Introduction to Organic Coatings

This course is intended to provide current scientific understanding in the field of organic coatings with a summary of the applied technology of the field. The objective of this course is to introduce coatings chemistry in a way that would fulfill the purpose of providing the beginner, involved in and having interest in organic coatings, with an easy-to-understand primer that might broaden his understanding of the subject later. This course introduces general science from a paint point of view, colloidal aspects of the subject, flow and dispersion of coatings, basics about paint

compositions including organic film former, solvents, pigments and additives. Introduction to corrosion and corrosion protection by coatings will also be addressed during this course. In addition, surface treatment and some special coatings for metallic substrates will be touched in this course.

GIFT675 Protective Coatings for Steel Corrosion

This class teaches the basic principle of various protective coating technologies commonly applied for steel products. Both organic and metallic coating technologies are discussed with various process parameters which determine the property of the coatings. The corrosion resistance of the coated steel products is studied in various corrosive environments. This course will also introduce general science from a paint point of view, colloidal aspects of the subject, flow and dispersion of coatings, basics about paint compositions including organic film former, solvents, pigments and additives. Introduction to corrosion and corrosion protection by organic coatings which are currently employed in industries will also be addressed during this course.

GIFT680 Advanced Control Theory and Applications

This class provides students with advanced control theory as well as general industrial applications. Characteristics of various systems are analyzed and synthesized for efficient controller design based on state space representation. Topics include fuzzy sets and systems, optimal control systems, nonlinear control and adaptive control systems, and their industrial.

GIFT681 Robotics

To provide an understanding of all the basic principles and techniques of robotic manipulator, including kinematics, inverse kinematics, Jacobian matrix, trajectory planning and various control technique. Also a comprehensive and up-to-date account of fundamentals of design, analysis and synthesis of robotic systems.

GIFT689 Special Topics in Control & Automation

Introducing fundamentals and approaches to intelligent systems and their applications in industrial control. Providing system modeling and intelligent controller design techniques through various industrial case studies.

GIFT694 Structure and Properties of Slags

To understand the basic of polymerized silicate-based glass structure, which will govern the various thermo-physical properties of ferrous slag system such as viscosity, thermal conductivity, electric conductivity, and refining capaci-ties. Other glass systems based on $CaO-A_2lo_3$ will also dealt with.

GIFT700 Introduction to Metallurgical Engineering

This course is offered to those students who have not taken any course related to the materials science and engineering during their undergraduate studies. The course is designed to provide the basic understanding of the metallurgy of irons and steels, including their structure, property and performance. Practical applications of ferrous materials are discussed with respect to the control of composition and microstructure by various thermal, mechanical and surface treatments.

GIFT701 Characterizations and Microanalysis

This course begins with an overview of fundamental physical and electronic theories underlying chemical and instrumental analysis for the determination of composition and structure of materials. The class will be directed towards systematically understanding the approximate principles of each instrument operation by combining the results of practical analysis, measurement, and testing and their application methods. Each student in the course is required to submit a modular report on a special experiment closely related to metallurgical processes and research with a special emphasis on how to interpret and utilize experimental results.

GIFT702 Solidification

The goal of this course is to enable the student to solve practical solidification processing problems through the application of solidification theory. The objectives of this course are to: (1) Develop solidification theory so that the student can understand solidification structure; (2) Develop a strong understanding of the role of heat transfer in castings; (3) Develop an appreciation for the strengths and weaknesses of a variety of casting processes. The first half of the course will be theoretical, covering nucleation, growth, instability, and solidification microstructure: cells, dendrite, eutectic and peritectic structures, solute redistribution, inclusion formation and separation, and defects and heat transfer problems. The second part of the course will be process oriented and will include conventional and near-net-shape casting, rapid solidification and spray casting with emphasis on process design to avoid defects.

GIFT703 Steel Production Technology

This course begins with an overview of process routes of an integrated steel works such as POSCO. The class will be directed towards systematically understanding the underlying principles of each process by positively using the e-learning web site of steel-university-org. The class will also drive the students to adapt themselves to the real processes by making them exercising the simulation programs of specific processes. Each student in the course is required to submit a modular report on a special topic closely related to metallurgical processes and research with a special emphasis on how to interpret and apply simulation results.