

### 3.1.5 Course descriptions

010623001 Thermodynamics of Materials 3(3-0-6)

Prerequisite : none

Postulates and laws of classical thermodynamics.

Thermodynamic potential and equilibrium condition. Maxwell's relations. Heat capacity and thermodynamics of simple reactions. Equilibrium of one-component and multi-phase system. Construction of binary phase diagram. Elementary tertiary phase diagram. Thermodynamics of reacting system consisting of multi-components and multi-phases. Reactions containing gaseous and condensed phases. Reactions containing multi-components in condensed solution. Electrochemistry. Statistical thermodynamic aspect to help explain the relevant macroscopic phenomena.

010623002 Mechanics of Materials 3(3-0-6)

Prerequisite : 010403003 Engineering Statics

Stress and strain mechanical properties of solids. Shaft bending. Stress in beams. Deformation and deflection of beams. Bending moment diagrams and shear force. Plane stress. Mohr's circle. Stability and buckling of columns.

010623003 Transport Phenomena in Materials Processing 3(3-0-6)

Prerequisite : none

Navier-Stokes equations. Laminar, turbulent and complex flow. Similarity and dimensional analyses. Flow in pipe. Heat transfer by conduction, convection and radiation. Macroscopic mass transfer. Fourier's law. Heat equation. Fick's first and second laws. Application of transport phenomena in materials engineering. Homogeneous and heterogeneous kinetics.

010623201	<p>Industrial Training</p> <p>Prerequisite : none</p> <p>Training in factory, engineering enterprises, and public or private institutes which their works concern the engineering profession. Engineering case studies in those organisations.</p>	0(0-240-0)
010623301	<p>Problem Solving Skills and Research Methodology in Materials Engineering</p> <p>Prerequisite : none</p> <p>On-line materials clinic. Survey of want and satisfaction of industries in the field of materials engineering to cultivate the academic problem-solving skills of students, to make them realised in their competency, to promote their self-esteem, and to make them understood the role of materials engineer. Active studying methods to make the students understood the meaning, types and importance of the research. Searching of research works from university's data bases. Experimental design and error. Data processing. Statistical data analyses. Intellectual properties and patenting. Mini-project in materials engineering.</p>	1(0-3-1)
010623302	<p>Materials Selection</p> <p>Prerequisite : none</p> <p>Materials selection based on the required properties. Design of component and products and economic consideration. Selection of manufacturing process and materials forming. Introduction to reverse engineering. Case study for materials and process selection.</p>	3(3-0-6)
010623303	<p>Physical Chemistry of Materials</p> <p>Prerequisite : 040113001 Chemistry for Engineers Or study with 010623303</p> <p>Crystal structure. Crystal defects. Crystal interfaces and microstructure. Solid solution and compound. Phase equilibrium diagrams. Solidification. Diffusion. Principle of solid-state phase transformation. Plastic deformation in crystalline solid. Recovery, recrystallisation and grain growth. Strengthening mechanism and microstructural control.</p>	3(3-0-6)

010623304 Mechanical Behavior of Materials 3(3-0-6)

Prerequisite : none

Stress-strain relationship of metals, ceramics and polymer. Mechanical behavior of composite materials. Effect of structural arrangement of materials on their mechanical properties. Elastic and plastic behaviors of materials. Dislocation theory. Mechanical testing, i.e. tensile, hardness, torsion, impact, fatigue and creep testing. Fracture mechanics. Failure of materials.

010623305 Materials Testing Laboratory 1(0-2-1)

Prerequisite : none

Mechanical testing, i.e. tensile, hardness, torsion, impact, fatigue and creep testing. Appearance of materials failure. Non-destructive testing. Galvanic corrosion. Electrolytic cells. Polarisation analysis. Anodic and cathodic corrosion protection.

010623306 Materials Electrochemistry 3(3-0-6)

Prerequisite : none

Thermodynamics of aqueous solutions. Kinetics of leaching and precipitation. Solvent extraction and ion exchange. Principle of hydrometallurgy. Electrochemistry of aqueous solutions. Current and energy efficiency. Principle of pyrometallurgy. Calcination, roasting and metal reduction. Extraction of ferrous and non-ferrous metals. Analytical methods in electrochemistry. Application in electrochemical engineering.

010623307 Chemical Degradation of Materials 3(3-0-6)

Prerequisite : 040113001 Chemistry for Engineers

Electrochemical thermodynamics of aqueous solution. Electrode kinetics and ion transfer in degradation phenomena. Appearance, causes and remedies of metallic corrosion. Chemical degradation of materials in various environments. Corrosion and chemical degradation testing. Material-centred and environment-centred materials selection. Case studies and selected research.

010623308 Failure Analysis of Materials 3(3-0-6)

Prerequisite : 010623304 Mechanical Behavior of Materials

010623307 Chemical Degradation of Materials

Principles and tools in failure analysis. Prevention of materials failure particularly in the practical aspect. Modes of failure. Materials behavior subjected to mechanical load, wear and oxidation. Failure due to thermal processes and corrosion reactions.

010623309 Quality Control and Management 3(3-0-6)

Prerequisite : 040503011 Statistics for Engineers and Scientists

Meaning and importance of quality. Techniques and methods used by the organization to achieve the quality required by customers. Management and statistical operation of quality control practiced in production and service industries. Quality system. Quality management system. Planning and implementation of the quality control system. Quality assurance. Application of the quality control and management for materials engineering.

010623310 Engineering Economy 3(3-0-6)

Prerequisite : none

Principles and application of time-varying values of money and interest. Decision to select a proposal under different conditions. Selection of project by present worth analysis, annual worth analysis, and internal rate of return analysis. Calculation of depreciation. Replacement analysis. Break even point analysis. Economic sensitivity analysis. Applications of engineering economy for materials engineering.

010623311 Materials Engineering Seminar 1(0-2-1)

Prerequisite : none

Seminar using Thai and English in the topics concerning materials research. Effective presentation. Good character in presentation. Manners in the meeting. Discussion on innovation in materials engineering, technological development and problems in materials engineering. Proposing materials engineering project.

- 010623312 Materials Engineering Project I 1(0-2-1)  
 Prerequisite : none  
 Research and technological development concerning materials engineering. Composing a senior project report explaining the conducted work. Presentation.
- 010623313 Materials Engineering Project II 3(0-6-3)  
 Prerequisite : 010623312 Materials Engineering Project I  
 Subject with the same content and continued from 010623312 Materials engineering project 1.
- 010623314 Analytical Methods in Materials Engineering 3(3-0-6)  
 Prerequisite : 040203211 Engineering Mathematics III  
 Partial differential. Legendre transformation and its application in classical thermodynamics. Vector analysis. Co-ordinate transformation. Introduction to tensor analysis. Application of vector and tensor analyses in mathematical modeling of transport phenomena. Ordinary differential equation. Fourier series. Integral transform. Solutions of partial differential equation using the technique of separation of variables. Special function. Bessel and Legendre functions. Solutions of partial differential equation using the transform method. Application in materials engineering.
- 010623315 Numerical Methods in Materials Engineering 3(3-0-6)  
 Prerequisite : 040203211 Engineering Mathematics III  
 Roots of equation. Linear equation systems. Interpolation and extrapolation methods. Least-square regression. Numerical integration and differentiation. Solving of ordinary differential equation. Solving of partial differential equation. Finite difference method. Introduction to finite element method. Application to the problems in transport phenomena, kinetics and mechanical behaviour of materials.

010623316 Phase Transformation 3(3-0-6)

Prerequisite : 010623303 Physical Chemistry of Materials

First-order phase transformation. Gibbs phase rule. Thermodynamics of binary phase diagram. Tertiary phase diagram. Critical phenomena and second-order phase transformation. Non-equilibrium phase diagram. Solidification. Diffusion-controlled phase transformation. Diffusionless phase transformation.

010623317 Surface Engineering 3(3-0-6)

Prerequisite : none

Preparation and surface analyses before coating. Case hardening by various methods to enhance hardness and wear. Carburising. Nitriding. Chemical and physical vapor deposition. Thermal spray. Ion implantation. Wear phenomena.

010623318 Non-Destructive Testing 3(3-0-6)

Prerequisite : none

Various techniques in non-destructive testing, e.g. those using liquid dye penetrant, eddy current, magnetic powders, ultrasonic wave, and radioactive imaging. Comparison and application of the non-destructive testing methods.

010623319 Tribology 3(3-0-6)

Prerequisite : none

Physical and chemical characteristics of materials surface. Friction between materials. Appearance and wear mechanisms for metals, polymers and ceramics. Surface damage. Boundary layer lubrication. Liquid and solid lubricants. Wear testing. Surface engineering to improve wear resistance. Case studies.

010623320 Safety in Materials Engineering 3(3-0-6)

Prerequisite : none

Causes and losses due to accident. Danger and its control from electrical machines. Boiler and pressure vessel. Materials handling. Safety due to the concern in heat, light, sound, vibration, radiation, chemicals, and bio-materials. Prevention and extinguishment of fire. Danger evaluation. Standard and laws concerning safety.

010623321 Energy and Environment in Materials Engineering 3(3-0-6)

Prerequisite : none

Situation and problems in energy and environment. Clean technology. Life cycle analysis of products. Energy management in materials industries. Pollutions from materials processing and remedies. Environmental regulations and standard for factories.

010623322 Special Topic in Materials Engineering 3(3-0-6)

Prerequisite : none

Study in the interesting topics in materials engineering.

010623323 Materials Characterisation 3(3-0-6)

Prerequisite : none

Basic chemical analyses. Spectroscopy techniques. X-ray characterizing techniques and microscopic electron spectroscopy. Quantification of phase and grain size using optical microscope. Analyses of phase transformation using thermal and dilatometric methods.

010623324 Metal Forming 3(3-0-6)

Prerequisite : none

Metal forming. Factors affecting deformation and formability of materials. Hot forming. Cold forming and recrystallisation. Forging. Rolling. Extrusion, drawing, and die materials. Parameters that control deformation and defects of the processes.

010623401 Metallurgy and Thermal Processing 3(3-0-6)

Prerequisite : none

Perfect crystal. Imperfect crystal. Equilibrium phase diagram of alloys. Non-equilibrium phase diagrams. Isothermal transformation diagram and continuous cooling diagram. Mechanisms of phase transformation. Strengthening mechanisms. Ferrous metals. Nonferrous metals. Annealing. Normalising. Hardening. Tempering. Stress-relief heat treatment.

010623402 Metallurgy and Thermal Processing Laboratory 1(0-2-1)

Prerequisite : 010623401 Metallurgy and Thermal Processing

Or study with 010623402

Laboratories in metallurgy and thermal processing with the content and practice corresponding to 010623401 Metallurgy and thermal processing.

010623403 Non-Metallic Materials 3(3-0-6)

Prerequisite : none

Classification of non-metallic materials. Polymeric materials. Rubber. Ceramics. Structure and properties of materials. Production of non-metallic materials. Application of non-metallic materials in engineering.

010623404 Extractive Metallurgy 3(3-0-6)

Prerequisite : none

Metal extraction by pyro- and electro-metallurgy. Roasting. Separation and reduction reactions. Slag-metal reaction. Electrolysis reactions using solution and molten salt electrolyte as a flux. Metallurgical reactor design.

010623405 Foundry Engineering 3(3-0-6)

Prerequisite : none

Basic casting. Advanced casting. Pattern. Cavity. Core and its materials. Sand casting box and binders. Testing and control of properties of sand. Refractory. Casting furnace. Gating and riser systems. Solidification. Ferrous and non-ferrous casting. Casting design. Defects and remedies of casted materials. Safety in casting shop.

010623406 Foundry Engineering Laboratory 1(0-2-1)

Prerequisite : 010623405 Foundry Engineering

Or study with 010623406

Practice in elementary casting. Making a pattern made of wood. Making cavity using humidified sand. Making cavity using sand with dry surface and core. Feeding of aluminium, brass and cast iron melts to mould.



010623407 Welding Metallurgy 3(3-0-6)

Prerequisite : none

Methods of welding. Soldering. Brazing. Solid state and fusion welding. Effect of welding parameters on structure and properties of metals. Welding metallurgy of ferritic steels, austenitic steels, and nonferrous metals. Behaviour of welded metals used in service.

010623408 Metal Forming Processes Laboratory 1(0-2-1)

Prerequisite : 010623324 Metal Forming

Or study with 010623408

Case studies of various methods of metal forming corresponding to the contents in 010623324 Metal forming. Theory and development of novel casting processes. Pattern design. Surface finishing and inspection of cast metal quality. Casting design. Theory of mechanical forming of metals and materials. Rolling. Forging. Extrusion through mould. Wire drawing. Causes and elimination of defects due to forming processes.

010623409 Iron and Steel Making 3(3-0-6)

Prerequisite : none

Ironmaking by blast furnace. Ironmaking by direct reduction and other alternative methods. Steelmaking by basic oxygen furnace and electric arc furnace. Refining process. Continuous casting process. Quality control in iron and steel making.

010623410 Solidification Processing 3(3-0-6)

Prerequisite : 010623405 Foundry Engineering

Macroscopic transport phenomena in solidification. Atomic diffusion through solid-liquid interface. Instability of solid-liquid interface. Cellular, dendritic, eutectic and peritectic microstructures after solidification. Microstructures of casted metals and ingots. Solute distribution during solidification. Rapid solidification.

010623411 Advanced Foundry Engineering 3(3-0-6)

Prerequisite : 010623405 Foundry Engineering

Casting technology of cast metals, copper, copper alloyed with aluminium, aluminium alloyed with magnesium, magnesium alloyed with zinc, and zinc alloys. Low pressure casting process. High pressure casting process. Compression casting process. Semi-solid casting process.

010623412 Advanced Foundry Engineering Laboratory 1(0-2-1)

Prerequisite : 010623406 Foundry Engineering Laboratory

Or study with 010623412

Solidification behaviour of metals analysed using thermal analysis. Modification of grain size and microstructure of cast metals. Laboratory of low pressure casting. High pressure casting process. Compression casting process. Semi-solid casting process.

010623413 Heat Treatment of Metals 3(3-0-6)

Prerequisite : none

Annealing. Normalising. Hardening. Tempering. Controlling of atmospheres in furnace. Case hardening by carburizing and nitriding. Heat treatment of tool steels, special steels, cast iron, and non-ferrous metals.

010623414 Laboratory on Heat Treatment of Metals 1(0-2-1)

Prerequisite : 010623413 Heat Treatment of Metals

Or study with 010623414

Practice in various methods of heat treatment, e.g. annealing, normalizing, hardening, tempering, case hardening. Microstructural analysis. Methods to measure case depth and other mechanical properties of work pieces after heat treatment.

010623415 Powder Metallurgy 3(3-0-6)

Prerequisite : none

Metallurgy of powders. Production of powders by mechanical and chemical methods, as well as atomisation. Characterisation of powders. Forming from powders and production of densified work pieces from powders. Methods to improve the properties of work piece. Microstructure and mechanical properties of work pieces made from powder metallurgical process. Application of metallic powders and work pieces made from powder metallurgical process.

010623416 Electroplating 3(3-0-6)

Prerequisite : 040113001 Chemistry for Engineers

Electrochemistry. Various types of plating processes. Chromium, nickel, copper, tin, tin alloy, zinc and zinc alloy plating. Control of plating variables. Defects and remedies.

010623417 Corrosion of Metals 3(3-0-6)

Prerequisite : none

Basics in thermodynamics and kinetics of corrosion. Uniform corrosion. Localised corrosion. Atmospheric corrosion. High temperature corrosion. Metallurgical-induced corrosion. Corrosion under stress and fatigue. Tribo-corrosion. Environment-induced corrosion. Corrosion protection. Cathodic method. Coating process. Application of corrosion inhibitors in industries, e.g. exploration and production industries as well as petrochemical and chemical industries. Case studies in corrosion science and engineering.

010623418 Cathodic Corrosion Protection 3(3-0-6)

Prerequisite : none

Design and system planning for corrosion protection using sacrificial anode and impressed current. Case studies in system planning of the cathodic protection in building, factory, pipelines in soil and sea and in transportation system e.g. in tram system.

010623419 Stainless Steels 3(3-0-6)

Prerequisite : none

Effects of alloying elements on structure and properties of stainless steels. Microstructure, physical properties, and mechanical properties of stainless steels. Passive film. Various groups of stainless steels, i.e. ferritic, martensitic, austenitic, duplex and precipitation-hardened stainless steels. Standards and criteria for the application of stainless steels in various works.

010623420 High-Temperature Materials 3(3-0-6)

Prerequisite : none

Reaction and transformation of materials in environmental media at high temperatures. Creep mechanism. Diffusion of vacancies. Movement of line defects and grain boundary. Materials selection for high temperature application.

010623421 Aluminium Processing Technology 3(3-0-6)

Prerequisite : none

Classification of wrought and cast aluminiums. Effects of alloying elements. Changing in forming technology. Various types of aluminiums. Casting, forging, rolling, welding, and strengthening of aluminium.

010623422 Special Topic in Metallurgical Engineering 3(3-0-6)

Prerequisite : none

Interesting topics in metallurgical engineering.

010623423 High Temperature Corrosion and Protection of Metals 3(3-0-6)

Prerequisite : 010623001 Thermodynamics of Materials

Thermodynamics and kinetics of high temperature corrosion. Defects and properties exhibited during high temperature corrosion. High temperature corrosion in various atmospheres, e.g. water vapour and carbon-containing atmospheres. Protection of surface. Metals used for high temperature corrosion. High temperature corrosion in various industries and case studies concerning corrosion science and engineering.