

## ระเบียบคณะกรรมการสภาวิศวกร

ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม  
ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตร  
ในการประกอบวิชาชีพวิศวกรรมควบคุม  
พ.ศ. ๒๕๕๘

โดยที่เป็นการสมควรปรับปรุงระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม

อาศัยอำนาจตามความในมาตรา ๓๓ (๓) แห่งพระราชบัญญัติวิศวกร พ.ศ. ๒๕๔๒ และข้อ ๘ ของข้อบังคับสภาวิศวกร ว่าด้วยการรับรองปริญญา ประกาศนียบัตร หรือวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๔ ประกอบกับมติที่ประชุมคณะกรรมการสภาวิศวกร ครั้งที่ ๕๒ - ๑๐/๒๕๕๘ เมื่อวันที่ ๑๔ กันยายน ๒๕๕๘ คณะกรรมการสภาวิศวกรจึงออกระเบียบไว้ดังต่อไปนี้

ข้อ ๑ ระเบียบนี้เรียกว่า “ระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๘”

ข้อ ๒ ระเบียบนี้ให้ใช้บังคับตั้งแต่วันถัดจากวันประกาศในราชกิจจานุเบกษาเป็นต้นไป

ข้อ ๓ ให้ยกเลิกระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๔

ข้อ ๔ วิชาพื้นฐานทางวิทยาศาสตร์ ให้เป็นไปตามรายละเอียด สาระของวิชา และแผนการจัดการศึกษา ที่กำหนดไว้ในบัญชีหมายเลข ๑ ท้ายระเบียบนี้

ข้อ ๕ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ให้เป็นไปตามรายละเอียด สาระของวิชา และแผนการจัดการศึกษา ที่กำหนดไว้ในบัญชีหมายเลข ๒ ท้ายระเบียบนี้

ข้อ ๖ ระเบียบนี้ไม่ใช้กับหลักสูตรที่สถาบันการศึกษาได้รับความเห็นชอบหลักสูตร ตามกฎหมายจัดตั้งสถานศึกษา ก่อนวันที่ระเบียบนี้ใช้บังคับ โดยให้นำระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกร จะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๔ มาใช้บังคับ

ประกาศ ณ วันที่ ๑๖ กันยายน พ.ศ. ๒๕๕๘

กมล ตรีกรบุตร

นายกสภาวิศวกร

**บัญชีหมายเลข ๑**  
**วิชาพื้นฐานทางวิทยาศาสตร์**

**๑ กลุ่มวิชาพื้นฐานทางคณิตศาสตร์** ไม่น้อยกว่า ๙ หน่วยกิต ตามระบบทวิภาค

Vector algebra in three dimensions; limit, continuity, differentiation and integration of real-valued and vector-valued functions of a real variable and their applications; techniques of integration; introduction to line integrals; improper integrals. Applications of derivative; indeterminate forms; introduction to differential equations and their applications; mathematical induction; sequences and series of numbers; Taylor series expansions of elementary functions; numerical integration; polar coordinates; calculus of real-valued functions of two variables. Lines; planes; and surfaces in three-dimensional space; calculus of real-valued functions of several variables and its applications.

**๒ กลุ่มวิชาพื้นฐานทางฟิสิกส์** ไม่น้อยกว่า ๖ หน่วยกิต ตามระบบทวิภาค

Mechanics of particles and rigid bodies; properties of matter; fluid mechanics; heat; vibrations and waves; elements of electromagnetism. A. C. circuits; fundamental electronics; optics; modern physics.

ทั้งนี้ ต้องมีการเรียนการสอนภาคปฏิบัติการด้วย จำนวน ๒ วิชา แต่สภาวิศวกรจะไม่นับหน่วยกิตภาคปฏิบัติการให้

**๓ กลุ่มวิชาพื้นฐานทางเคมี** ไม่น้อยกว่า ๓ หน่วยกิต ตามระบบทวิภาค

Stoichiometry and basis of the atomic theory; properties of gas, liquid, solid and solution; chemical equilibrium; ionic equilibrium; chemical kinetic; electronic structures of atoms; chemical bonds; periodic properties; representative elements; nonmetal and transition metals.

ทั้งนี้ ต้องมีการเรียนการสอนภาคปฏิบัติการด้วย แต่สภาวิศวกรจะไม่นับหน่วยกิตภาคปฏิบัติการให้

บัญชีหมายเลข ๒  
วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม

๑ สาขาวิศวกรรมโยธา

วิชาพื้นฐานทางวิศวกรรม

๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Applied Mathematics / Differential Equations
๖ Strength of Materials / Mechanics of Materials
๗ Fluid Mechanics & Laboratory / Hydraulics & Laboratory
๘ Surveying & Field Camp (๘๐ hours)

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

(๔) รายวิชาที่ระบุว่าจะต้องมีการเรียนการสอนภาคปฏิบัติ (Practices) หรือการปฏิบัติการ (Laboratory) ด้วย สภาวิศวกรจะไม่นับรวมหน่วยกิตภาคปฏิบัติ (Practices) หรือการปฏิบัติการ (Laboratory) ให้ในกลุ่มวิชาพื้นฐานทางวิศวกรรม แต่จะนับรวมในวิชาเฉพาะทางวิศวกรรม (๘๔ หน่วยกิต)

(๕) ต้องมีการจัดการเรียนการสอนให้เป็นไปตามลำดับการเรียนรู้

วิชาเฉพาะทางวิศวกรรม

๑ Structural Analysis
๒ Reinforced Concrete Design & Practice
๓ Soil Mechanics & Laboratory
๔ Civil Engineering Materials and Testing
๕ Steel and Timber Design & Practice / Foundation Engineering & Practice
๖ Hydraulic Engineering / Water Resources Engineering
๗ Highway Engineering / Transportation Engineering / Pavement Design / Railway Engineering / Route Surveying / Photogrammetry
๘ Construction Engineering and Management / Construction Techniques

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีหน่วยกิตรวมไม่น้อยกว่า ๒๔ หน่วยกิต

(๒) รายวิชาในกลุ่มที่ ๑-๖ ให้เลือกกลุ่มละ ๑ วิชา ส่วนรายวิชาในกลุ่มที่ ๗ และ ๘ ให้เลือก ๒ วิชาโดยจะเลือกจากกลุ่มใดกลุ่มหนึ่งหรือทั้งสองกลุ่มก็ได้

(๓) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๔) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

(๕) รายวิชาที่ระบุว่าต้องมีการเรียนการสอนภาคปฏิบัติ (Practices) หรือการปฏิบัติการ (Laboratory) ด้วย สภาวิศวกรจะไม่นับรวมหน่วยกิตภาคปฏิบัติ (Practices) หรือการปฏิบัติการ (Laboratory) ให้ในกลุ่มวิชาพื้นฐานทางวิศวกรรม แต่จะนับรวมในวิชาเฉพาะทางวิศวกรรม (๘๔ หน่วยกิต)

(๖) ต้องมีการจัดการเรียนการสอนให้เป็นไปตามลำดับการเรียนรู้

**เนื้อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมโยธา**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Applied Mathematics / Differential Equations**

**Applied Mathematics**

Linear algebra; introduction to the theory of approximations; solution of algebraic and transcendental equations; solutions of linear systems; first and second order differential equations; Fourier transforms and Laplace transforms; vector calculus.

**Differential Equations**

Homogeneous, first - and second - order linear differential equations with constant coefficients; nonhomogeneous differential equations; (Fourier transforms and Laplace transforms); Third - and higher -order linear differential equations with constant coefficients; numerical methods for differential equations; some applications to civil engineering systems.

**๖ Strength of Materials / Mechanics of Materials**

Forces and stresses; stresses and strains relationship; stresses in beams, shear force and bending moment diagrams; deflection of beams, torsion; buckling of columns; Mohr's circle and combined stresses; failure criterion.

**๗ Fluid Mechanics & Laboratory / Hydraulics & Laboratory****Fluid Mechanics & Laboratory**

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; similitude and dimensional analysis; steady incompressible flow.

**Hydraulics & Laboratory**

Properties of fluids, fluid statics, kinematics of fluid flow, energy equation in a steady flow, momentum and dynamic forces in fluid flow, similitude and dimensional analysis, flow of incompressible fluid in pipes, open-channel flow, fluid measurements, unsteady flow problems.

**๘ Surveying & Field Camp (๘๐ hours)**

Introduction to surveying work; basic field works, leveling; principles and applications of theodolites; distance and direction measurements; errors in surveying, acceptable error, data correction, triangulation; precise determination of azimuth; precise traverse plane coordinate system, precise leveling; topographic survey; map plotting.

**เนื้อหารายวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมโยธา**

**๑ Structural Analysis**

Introduction to structural theory; reactions, shears and moments in statically determinate structures; graphic statics; influence lines of determinate structures; deformations of determinate structures by methods of moment- area, conjugate beam, virtual work, energy theorem.

Analysis of statically indeterminate structures by method of consistent deformation, methods of slope and deflection, moment distribution, influence lines of indeterminate structures; approximate analysis; introduction to matrix structural analysis and plastic analysis.

**๒ Reinforced Concrete Design & Practice**

Concrete and reinforcement; fundamental behavior in axial load, flexure, torsion, shear, bond and combined actions; design of reinforced concrete structural components by working stress and strength design methods; design practice.

**Practice**

Practice in reinforced concrete design and detailing

**๓ Soil Mechanics & Laboratory**

Soil formation, index properties and classification of soil, compaction, permeability of soil and seepage problems, principle of effective stresses within a soil mass; stress distribution, compressibility of soil, shear strength of soil, earth pressure theory, slope stability, bearing capacity

**๔ Civil Engineering Materials and Testing**

Fundamental behaviors and properties, introduction to inspection and testing of various civil engineering materials, steel and rebar, wood, cement, aggregates and admixtures, mix design; fresh and hardened concrete, highway materials, other civil engineering materials.

**๕ Steel and Timber Design & Practice / Foundation Engineering & Practice**

**Steel and Timber Design**

Design of steel and timber structures; tension and compression members; beams; beam-columns; built-up members; plate girders; connections; ASD and LRFD methods, design practice.

**Practice**

Practice in steel and timber design and detailing

### **Foundation Engineering**

Subsurface investigation, bearing capacity of foundation, spread and pile foundation design, settlement analysis, earth pressure problems and retaining structures and sheet pile wall; elementary of soil improvement; introduction to mat and caisson foundation design; introduction to open cut and braced cut; design practice.

#### **Practice**

Practice in foundation engineering and detailing.

### **๖ Hydraulic Engineering / Water Resources Engineering**

#### **Hydraulic Engineering**

Application of fluid mechanic / hydraulic principles to study and practice of hydraulic engineering; piping systems; water hammer; pumps and turbines; open channel flow; design of reservoir, dams, spillways; hydraulic models, drainage system.

#### **Water Resources Engineering**

Project planning, basin system analysis of planned project by modeling, preliminary design of project components, economic analysis, water management on basin systems by modeling, reservoir rule curves, case studies.

### **๗ Highway Engineering / Transportation Engineering / Pavement Design / Railway Engineering / Route Surveying / Photogrammetry**

#### **Highway Engineering**

Historical development of highways; highway administration; principles of highway planning and traffic analysis; geometric design and operations; highway finance and economic; introduction to pavement design; highway materials; construction and maintenance of highways.

#### **Transportation Engineering**

Planning, design and evaluation of transportation systems, transportation models; water transportation; pipeline transportation; road transportation; railway transportation; air transportation.

#### **Pavement Design**

Principles of highway and airport pavements including pavement types and wheel loads; stresses in flexible and rigid pavements; consideration of properties of pavement components including for highway and airport; methods of design of flexible and rigid pavements for highways and airport; pavement drainage; methods of construction and maintenance.



### **Railway Engineering**

Introduction to railway engineering and rail infrastructures and their impacts on the society and environment, rail alignment, track geometry, superstructures and substructure components, switches, railway planning and capacity, power supply and signaling control system, operation and maintenance of railway.

### **Route Surveying**

Surveying techniques; route location and design; horizontal and vertical curves; earthwork; alignment layout; route construction survey

### **Photogrammetry**

Basic concepts of photogrammetry; cameras and photography; flight planning; geometry of photograph; photogrammetric methods, mosaic, rectification, orthophotography, stereoscopic plotting.

## **๘ Construction Engineering and Management / Construction Techniques**

### **Construction Engineering and Management**

Project delivery systems; project organization; site layout; project planning; modern construction technology; construction equipments; critical path method (CPM); resource management; progress measurement; construction safety; quality systems.

### **Construction Techniques**

Planning and selection of site layout, equipment and various construction systems: excavation; shoring; ground anchorage; underpinning; piling; formwork; craneage; material handling. pre-stressed and pre-cast concrete construction. construction methods and method statement with minimal impact on the environment; related construction code and laws requirements; integration and coordination of services; demolition; advanced construction techniques.

## ๒ สาขาวิศวกรรมเหมืองแร่

## วิชาพื้นฐานทางวิศวกรรม

งานเหมืองแร่	งานโลหการ
๑ Engineering Drawing	
๒ Engineering Mechanics	
๓ Engineering Materials	
๔ Computer Programming	
๕ Thermodynamics / Thermodynamics of Materials	๕ Thermodynamics of Materials
๖ Mechanics of Materials / Strength of Materials	
๗ Fluid Mechanics	๗ Transport Phenomena
๘ Fundamental of Electrical Engineering	

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชา และมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหารายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

## วิชาเฉพาะทางวิศวกรรม

งานเหมืองแร่	งานโลหการ
๑ Surface Mining and Mine Design	๑ Chemical Metallurgy
๒ Underground Mining and Mine Design	๒ Physical Metallurgy
๓ Mine Economics	๓ Mechanical Behaviour of Materials
๔ Geotechniques / Blasting Technology	๔ Materials Characterization
๕ Mineral Processing I	๕ Metal Forming
๖ Mineral Processing II / Separation Technology / Ground Water Engineering	๖ Corrosion of Metals
๗ General Geology / Chemistry of Materials / Material Characterization	๗ Failure Analysis
๘ Mine Planning and Design / Geostatistics / Georesources Environmental and Pollution Prevention	๘ Metallurgy of Metal Joining / Materials Selection / Materials Selection and Design

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชา และมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหารายวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

**เนื่อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมเหมืองแร่**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Thermodynamics / Thermodynamics of Materials**

**Thermodynamics**

First law of thermodynamics; second law of thermodynamics and Carnot cycle; energy; entropy; basic heat transfer and energy conversion.

**Thermodynamics of Materials**

First and second laws of thermodynamics. Criteria for equilibria in constant pressure processes. Free energy as a function of temperature, pressure and chemical potential. Equilibrium in gas mixtures. Equilibrium between condensed phases and gas phases. Free energy diagram. Solution behavior.

**๖ Mechanics of Materials / Strength of Materials**

Forces and stresses; stresses and strains relationship; stresses in beams, shear force and bending moment diagrams; deflection of beams, torsion; buckling of columns; Mohr's circle and combined stresses; failure criterion.

**๗ Fluid Mechanics / Transport Phenomena**

**Fluid Mechanics**

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; similitude and dimensional analysis; steady incompressible flow.

**Transport Phenomena**

Laminar flow and turbulent flow. Newton's viscosity law. Mass-balance equation. Momentum-balance equation. Similitude and dimensional analysis. Flow in pipe. Conduction, convection and radiation. Energy-balance equation. Fick's law of diffusion.

**∞ Fundamental of Electrical Engineering**

Basic DC and AC circuit analysis; voltage; current and power; transformers; introduction to electrical machinery; generators, motors and their uses; concepts of three-phase systems; method of power transmission; introduction to some basic electrical instruments.

**เนือหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมเหมืองแร่**

**งานเหมืองแร่**

**๑ Surface Mining and Mine Design**

Exploration, evaluation and development of mineral deposits. Classification and application of various surface mining methods. Earth and rock excavations. Drilling and blasting techniques. Environmental protection, mine welfare and safety.

**๒ Underground Mining and Mine Design**

Underground exploration and evaluation. Classification and application of various underground mining methods. Drilling and blasting technique for underground excavation. Introduction to underground support, ventilation, drainage and illumination. Applications of subsidence and ground control. Underground mine welfare and safety.

**๓ Mine Economics**

Concepts of demand and supply and their applications to mining industry. Cost estimation for mining operation. Investment decision techniques. Mineral property valuation. Risk analysis techniques. Mining project financing.

**๔ Geotechniques / Blasting Technology**

**Geotechniques**

Engineering properties of soil and rocks. Soil and rock measurements and classification. Stress-strain analysis. Failure criteria. Stability analysis. Geotechnical application to soil and rock excavations.

**Blasting Technology**

Composition and properties of explosives, blasting theory and applications of explosives in mining, principles of operation and selection of rock drills, blasting design, controlled blasting, drilling and blasting economics, blasting and environment, and blasting regulations and safety.

**๕ Mineral Processing I**

Physical methods of mineral processing. Fundamental of mineral processing including sampling, comminution and liberation, screening, classification, size determination, gravity concentration, magnetic and electrostatic separation. Construction of flow sheets for mineral processing plants.

**๖ Mineral Processing II / Separation Technology / Ground Water Engineering**

**Mineral Processing II**

Theory and practice of froth flotation. Flocculation and coagulation. Solid-liquid separation, thickening, filtration and drying. Chemical processing of minerals. Construction of complex flow sheets for mineral processing plants.

### **Separation Technology**

General description of separation and classification efficiency; hydrocyclones, screens, electrostatic precipitators; mixing, granulation, crystallisation; comminution matrix description of size reduction, milling circuit simulation, size enlargement and agglomeration; motion of particles in fluids; flow of fluids through granular beds; incompressible and compressible cake filtration; gravity sedimentation and clarification; pneumatic and hydraulic transport of solids; surface chemistry and thermodynamics of particles-bubbles attachment; mechanisms of mineral flotation; kinetics of mineral flotation and mechanics; flotation processes of minerals and materials.

### **Ground Water Engineering**

Hydrologic cycle, groundwater geology, Bernoulli's equation, Darcy's law flow, net construction, laboratory and in-situ measurements, effects of groundwater on engineering structures.

### **๗ General Geology / Chemistry of Materials / Material Characterization**

#### **General Geology**

Scope of geology; the universe and the earth; surface features of the earth's crust and the geological processes; deformation of the earth's crust; mineral and rocks; rock structures; geological maps and sections; field techniques in geological mapping; collection of field specimens; well logging and drill core; preparation of geological maps and reports.

#### **Chemistry of Materials**

Thermochemistry. Phase equilibria and physical properties of matter. Solution chemistry. Colloid and surface chemistry for materials separation. Electrochemistry and principles of corrosion. Chemical analysis and spectroscopic techniques.

#### **Material Characterization**

Basic chemical analysis and spectroscopic techniques. Materials characterization by X-ray and electron microscopic techniques.

### **๘ Mine Planning and Design / Geostatistics / Georesources Environmental and Pollution Prevention**

#### **Mine Planning and Design**

Concepts of mine planning and design. Selection of heavy equipment. Application of relevant knowledge in mining on mine design. Mine management. Quality control and maintenance. Computer application and simulation in mine design.

#### **Geostatistics**

Introduction to geostatistics; spatial data and geostatistical approach; problems and geostatistical solution; structure of regionalized variable and its applications on sampling analysis and optimization; kriging systems and characteristic features; estimator and estimation variance; and use of computer codes.

### **Georesources Environmental and Pollution Prevention**

Major environmental problems and impacts from production and utilization of georesources (minerals); scope of environmental impact assessment; environmental technology to manage and control the problems; waste minimization, disposal and waste utilization; environmental planning for the development and utilization of georesources (minerals).

**เนือหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมเหมืองแร่**

**งานโลหการ**

**๑ Chemical Metallurgy**

Principles of hydrometallurgy, including thermodynamics of aqueous solutions, kinetics of leaching and precipitation, solvent extraction and ion exchange. Electrochemistry of aqueous solution, current and energy efficiency. Principles of pyrometallurgy, including thermodynamic applications, calcination, roasting and metal reduction. Extraction of ferrous and nonferrous metals.

**๒ Physical Metallurgy**

Crystal structure. Crystal defects. Crystal interfaces and microstructure. Solid solution and compound. Phase equilibrium diagrams. Solidification. Diffusion. Principles of solid-state phase transformation. Plastic deformation in crystalline solid. Recovery, recrystallization, grain growth. Strengthening mechanism and microstructural control.

**๓ Mechanical Behaviour of Materials**

Elastic behaviour. Theory of plasticity. Dislocation theory. Introduction to fracture mechanics. Mechanical failure such as creep and fatigue. Mechanical testing.

**๔ Materials Characterization**

Basic chemical analysis and spectroscopic techniques. Materials characterization by X-ray and electron microscopic techniques.

**๕ Metal Forming**

Theory and modern development of foundry processes. Gating and riser design. Pattern design. Finishing and inspection of castings. Casting design. Theory of mechanical forming processes of metals i.e. rolling, forging, extrusion, drawing and sheet metal forming. Source and elimination of defects.

**๖ Corrosion of Metals**

Principles of corrosion. Forms of corrosion. Corrosion prevention, controls and materials selection. Degradation of engineering materials. Corrosion testing.

**๗ Failure Analysis**

Mechanical fracture. Failure due to corrosion. Defects due to thermal processes. Failure analysis tools.

**๘ Metallurgy of Metal Joining / Materials Selection / Materials Selection and Design**

**Metallurgy of Metal Joining**

Introduction to metal joining, soldering, brazing and welding. Weldability of various metals and alloys. Metallurgical effects of the weld thermal cycle. Introduction to quality assurance and control in joining processes



**Materials Selection**

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; cases study for materials and process selection.

**Materials Selection and Design**

Criteria and concept in design; materials selection process; material property charts; effects of composition, processing, and structure on materials properties; properties versus performance of materials; case studies of materials processing and design; case studies of materials selection.

### ๓ สาขาวิศวกรรมเครื่องกล

#### วิชาพื้นฐานทางวิศวกรรม

๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Thermodynamics
๖ Fluid Mechanics
๗ Strength of Materials / Mechanics of Materials
๘ Manufacturing Process

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

#### วิชาเฉพาะทางวิศวกรรม

๑ Mechanics of Machinery
๒ Machine Design
๓ Automatic Control
๔ Mechanical Vibration
๕ Heat Transfer
๖ Computer Aided Mechanical Engineering Design
๗ Internal Combustion Engines / Combustion / Internal Combustion Engines for Agricultural Systems / Combustion Technology for Food Engineering / Air Conditioning / Refrigeration / Refrigeration and Air Conditioning / Industrial Refrigeration , Freezing, Cold Storage / Refrigeration and Cold Storage Systems / Aircraft Air Conditioning and Pressurization Systems / Power Plant Engineering / Power Generation and Environmental / Power for Agricultural Systems / Power Systems in Food Industry / Ship Propulsion and Engines / Ship Resistant and Powering / Aircraft Power Plant / Aerospace Propulsion / Thermal System Design / Renewable Energy for Agriculture / Grain Drying / Boiler and Gas Turbines / Marine Engineering / Fluid Machinery in Food Industry / Energy Utilization in Food Industry / Alternative and Renewable Energy Resources / Food Thermal Process Engineering / Agricultural Process Engineering

๘ Railway Rolling Stock / Friction and Wear / Mechanics of Vehicles / Robot Actuators and Sensors / Agricultural Machinery Engineering / Food Mechanical Process Engineering / Material Handling Engineering / Flight Dynamics and Control / Aircraft Structure Analysis / Mechatronics / Aircraft Design / Space Systems Design / Mechanics of Flight / Mechanics of Spaceflight / Ship Hydrostatics and Stability / Ship Strength / Shipbuilding Engineering / Food Product Conveying Equipment Design / Hygienic and Sanitary Design for Plant / Safety of Motor Vehicle / Agricultural Tractor Engineering / Agricultural Machinery / Vehicle System Design

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีหน่วยกิตรวมไม่น้อยกว่า ๒๔ หน่วยกิต

(๒) รายวิชาในกลุ่มที่ ๑-๖ ให้เลือกกลุ่มละ ๑ วิชา ส่วนรายวิชาในกลุ่มที่ ๗ และ ๘ ให้เลือก ๒ วิชา โดยจะเลือกจากกลุ่มใดกลุ่มหนึ่งหรือทั้งสองกลุ่มก็ได้

(๓) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๔) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

**เนื่อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมเครื่องกล**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Thermodynamics**

First law of thermodynamics; second law of thermodynamics and Carnot cycle; energy; entropy; basic heat transfer and energy conversion.

**๖ Fluid Mechanics**

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; similitude and dimensional analysis; steady incompressible flow.

**๗ Strength of Materials หรือ Mechanics of Materials**

Forces and stresses; stresses and strains relationship; stresses in beams, shear force and bending moment diagrams; deflection of beams, torsion; buckling of columns; Mohr's circle and combined stresses; failure criterion.

**๘ Manufacturing Processes**

Theory and concept of manufacturing processes such as casting, forming, machining and welding; material and manufacturing processes relationships; fundamental of manufacturing cost.

**เนือหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมเครื่องกล**

**๑ Mechanics of Machinery**

Velocity and acceleration analysis; kinematics and dynamics force analysis, applications and balancing of mechanical systems.

**๒ Machine Design**

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, design project.

**๓ Automatic Control**

Automatic control principles, analysis and modeling of linear control elements, stability of feedback systems, design and compensation of control systems.

หรือ Fluid Power Control: Basic fluid mechanics, flow, pressure, energy, basic components, pump, valve, motor, fluid power systems, static and dynamic characteristics, feedback control, sensor, controller, actuator, control action, transfer function, sequence control.

**๔ Mechanical Vibration**

Systems with one degree of freedom, torsional vibration, free and forced vibration, method of equivalent systems, systems having several degrees of freedom, methods and techniques to reduce and control vibration.

**๕ Heat Transfer**

Modes of heat transfer, conduction, convection, radiation and applications of heat transfer, heat exchangers and heat transfer enhancement, boiling and condensation.

**๖ Computer Aided Mechanical Engineering Design**

Use of computer for design and analysis of mechanical engineering problems. Physical modeling and simulations of mechanical engineering problems and related applications.

**๗ Internal Combustion Engines / Combustion / Internal Combustion Engines for Agricultural Systems / Combustion Technology for Food Engineering / Air Conditioning / Refrigeration / Refrigeration and Air Conditioning / Industrial Refrigeration, Freezing, Cold Storage / Refrigeration and Cold Storage Systems / Aircraft Air Conditioning and Pressurization Systems / Power Plant Engineering / Power Generation and Environmental / Power for Agricultural Systems / Power Systems in Food Industry / Ship Propulsion and Engines / Ship Resistant and Powering / Aircraft Power Plant / Aerospace Propulsion / Thermal System Design / Renewable Energy for Agriculture / Grain Drying / Boiler and Gas Turbines / Marine Engineering / Fluid Machinery in Food Industry / Energy Utilization in Food**

## Industry / Alternative and Renewable Energy Resources / Food Thermal Process Engineering / Agricultural Process Engineering

### Internal Combustion Engines

Internal combustion engine fundamentals, spark-ignition and compression-ignition engines, fuels and combustion, ignition systems, ideal fuel air cycle, supercharging and scavenging, performance and testing, lubrication.

### Combustion

Combustion stoichiometric analysis, energy-temperature analysis, physical properties of fuels, gas and oil burners, laminar and turbulent flames, turbulent flame structure, diffusion and premixed flames, flame stability, control of pollution from combustion.

### Internal Combustion Engines for Agricultural Systems

Power used in agriculture, internal combustion engine fundamentals, fuels and combustion, ignition systems, fuel-air cycle, supercharging and scavenging, lubrication and cooling, performance and testing, remedy and maintenance of tractor engine.

### Combustion Technology for Food Engineering

Theory of combustion, physical properties of solid, liquid, fuel gas and biomass fuels; gas and oil burner, equipment used in combustion, utilization of heat from combustion to food systems, application for boiler, drying systems, food processing, control of pollution from combustion.

### Air Conditioning

Psychometric properties and processes of air, cooling load estimation, air conditioning equipment, various types of air conditioning systems, air distribution and duct system design, ventilation system design, refrigerants and refrigerant piping design, basic controls in air conditioning, fire safety in a/c systems, indoor air quality, energy efficiency in a/c systems.

### Refrigeration

Review of thermodynamics, psychometric property of air and introduction of refrigeration, ideal and real refrigeration processes, multi-pressure refrigeration process, refrigerant and lubricating oil, refrigeration load calculations, compressors, condensers, evaporators, refrigerant expansion/metering devices and level control, refrigerant controls, valve components, electrical control and monitoring systems, refrigerant piping and vessel design, safety.

### Refrigeration and Air Conditioning

Basic knowledge of refrigeration and coefficient of performance, modified vapor compression, refrigeration cycles, system components analysis, refrigerant and their properties, evaporative cooling and cooling towers, absorption refrigeration, calculation of cooling load of refrigeration systems, freezing of foods, air condition, cooling load estimation of air conditioning systems, air distribution and duct system design.

### **Industrial Refrigeration, Freezing, Cold Storage**

Principle of refrigeration, introduction to psychometrics, refrigeration equipment and accessories, food products and their preservation by refrigeration, food preservation, special food preservation method and other applications, insulation technique, cold storage construction, heat load calculations, economic consideration of refrigeration systems, heat reclaim, heat recovery and storage of energy, plant maintenance, safety.

### **Refrigeration and Cold Storage Systems**

Principle of refrigeration, compression gas, absorption and special type; refrigeration systems; refrigerant compressor, evaporator, condenser, controlling systems, piping and equipment; load calculation of cold storage; psychometric and ventilation, circulation of air in cold storage and duct system design; air conditioning systems; preservation of agricultural products and food with cold storage, low temperature refrigeration systems and cryogenic technique.

### **Aircraft Air Conditioning and Pressurization Systems**

Psychometric, thermodynamics of heating and cooling, systems of air conditioning and pressurization of aircraft, maintenance and operation of air conditioning and pressurization systems in airline industry, air quality control in passenger cabin, safety in air conditioning and pressurization of commercial aircraft based on international regulations.

### **Power Plant Engineering**

Energy conversion principles and availability concept, fuels and combustion analysis and component study of steam, gas turbine and internal combustion engine power plants, combined cycle and cogeneration, hydro power plant, nuclear power plant, control and instrumentation, power plant economics and environmental impacts.

### **Power Generation and Environment**

Thermal power plants : steam turbine, gas turbine, and cogeneration, hydro power plants, nuclear safety and waste treatment, atmospheric, land and water environment for power plants, introduction to environment impact assessment for power plants.

### **Power for Agricultural Systems**

Thermodynamics of engine, fuel & combustion, internal combustion engine, hydro power plant, steam power plant, gas turbine & combined cycle power plant, renewable energy.

### **Power Systems in Food Industry**

Energy conversion systems; steam generator; fuel and combustion; condensate, feed water and cooling water systems; steam power plant; energy conservation techniques for motor and transformer; energy management and economy in food industry, energy audit and monitoring.

### **Ship Propulsion and Engines**

Introduction to marine propulsion systems, marine diesel engine and auxiliary systems, marine gas turbines, propellers, propulsion power transmission and piping system design.

### **Ship Resistant and Powering**

Frictional resistance, residuary resistance, wave making resistance, Froude's law of comparison; model tests; powering of ships; estimation of effective horsepower; propulsion and propellers horse-power, wake thrust deduction, hull efficiency, propellers, geometry of the screw propeller, propellers and law of similarity, design procedure.

### **Aircraft Power Plant**

Fundamental laws and equations, thermodynamics cycles, turbojet, turbofan, turboprop/turbo shaft, component performance, propellers, rockets.

### **Aerospace Propulsion**

Thermodynamics cycles of propulsion systems, basic combustion, analysis of aerospace propulsion systems, piston engines, turbojet, turboshaft, turboprop, turbofan, ramjet, rocket propulsion.

### **Thermal System Design**

Engineering design, design of workable systems, economic analysis on thermal systems, equation fitting, model of thermal equipment, system simulation, optimization.

### **Renewable Energy for Agriculture**

Applications study of energies from solar, wind, water, wood, biogas, and agricultural leftover materials, charcoal production and stove types, solar meter, wind energy, small turbine, biogas pool.

### **Grain Drying**

Principle and system of grain drying, moist air properties, equilibrium moisture content, thermal properties of grain and moisture transfer in porous materials, mathematical modeling of grain drying, deterioration and its minimization in storage.

### **Boiler and Gas Turbines**

Type of boiler, principle of boiler and gas turbine, properties of steam control systems and alarms, the use of steam turbines in the sea, gas cycle, Brayton cycle, Rankine cycles, test and improve the water quality of the steam generator, inspection of steam boiling, gas turbines maintain and modify.

### **Marine Engineering**

Marine machinery; types and their layout, such as pump, fans, steering gear mechanism, anchoring device, winches and cranes; propulsion; propeller geometry and definition; lift and drag; momentum and blade element theories; steering and design of rudders; ship auxiliary services; ventilation, refrigeration, air conditioning, pumping, flooding and draining; waste heat utilization.



### **Fluid Machinery in Food Industry**

Classification and characteristics of pumps, blowers and compressors used in hydraulic and pneumatic system; calculation of capacity and efficiency of fluid machinery; design of piping system for fluid distribution; application and solution of occurring problems of fluid machinery in food industry.

### **Energy Utilization in Food Industry**

Analysis and measurement of performance of energy utilization in thermal and electrical system for air conditioning systems, refrigeration systems, hot water/steam systems, air compression systems, electrical motor systems, lighting systems, energy conservation techniques, energy situation and concepts of energy conservation.

### **Alternative and Renewable Energy Resources**

Introduction to fundamental of alternative energy and renewable energy resources, solar energy, biomass energy, biogas energy, wind energy, geothermal, hydro energy, the use of renewable energy in daily life.

### **Food Thermal Process Engineering**

Theories and principles related to unit operations in food engineering: evaporation, distillation, extraction, leaching, absorption and ion exchange; principles of non-direct heating food process engineering: microwave, radio frequency, infrared, ohmic

### **Agricultural Process Engineering**

Mass and energy balance in agricultural material processing, process measurement and instruments, drying and dehydration, thermal processing and cold storage of agricultural material, optimization in agricultural process engineering, agricultural process equipment.

๘ **Railway Rolling Stock / Friction and Wear / Mechanics of Vehicles / Robot Actuators and Sensors / Agricultural Machinery Engineering / Food Mechanical Process Engineering / Material Handling Engineering / Flight Dynamics and Control / Aircraft Structure Analysis / Mechatronics / Aircraft Design / Space Systems Design / Mechanics of Flight / Mechanics of Spaceflight / Ship Hydrostatics and Stability / Ship Strength / Shipbuilding Engineering / Food Product Conveying Equipment Design / Hygienic and Sanitary Design for Plant / Safety of Motor Vehicle / Agricultural Tractor Engineering / Agricultural Machinery / Vehicle System Design**

### **Railway Rolling Stock**

Introduction to railway rolling stock and major components. Overview of rail vehicle dynamics, longitudinal rail vehicle dynamics (traction and brake), wheel and rail contact, ride Comfort, bogie, suspension, brake system and rail coach body. Some of rolling stock monitoring/maintenance and basic design Concept are introduced.

### **Friction and Wear**

Introduction to tribology in rail machine components, Normal contact of elastic solids, Rail-wheel friction and friction modification, Wear and surface damage mechanism in rail wheel interface, Lubrication in rail Wheel interface, Wear prediction of collector strip and contact wire in pantograph, Wear characteristics of braking systems for railway vehicles, Wear characteristics of axle.

### **Mechanics of Vehicles**

Acceleration and braking performance, road loads, resistance forces and required power, engine performance and converse, steady-state cornering, ride dynamics, steering and suspension systems, tired characteristics, rollover dynamics, and mechanics of vehicle's weight transfer.

### **Robot Actuators and Sensors**

Introduction to modeling and use of actuators, sensors and microcontrollers in mechatronics design. Topics include electric motors (AC, DC, Stepper), solenoids, micro-actuators, position sensors (Encoders, sonar, Infrared), proximity sensor and micro-controller.

### **Agricultural Machinery Engineering**

Mechanical properties of soil and plant related to agricultural machinery design; principles of agricultural machinery operations; principles of agricultural machines and farm implements design: tillage equipments, planting and cultivating equipments, harvesting machines; testing and performance evaluation agricultural machines; agricultural machinery standards; introduction to economics and agricultural machinery management

### **Food Mechanical Process Engineering**

Theories and principles related to unit operations in food engineering: size reduction, mechanical separations for solid and liquid foods, precipitation, agitation and mixing of solid and liquid foods, filtration and membrane separation, crystallization and extrusion; principles of food process engineering related to heating or cooling: retorting and freezing

### **Material Handling Engineering**

Physical properties and agricultural product of engineer, types of handling, character of material devided by principles of handling, design, materials flow motion system, analysis technique flow motion of material, principles of selection suitable material handling, and design major handling material, such as: gravities conveyor, belts conveyor, screw conveyor, pneumatic conveyor, bucket conveyor.

### **Flight Dynamics and Control**

Advanced topics in aircraft dynamics, Trimmed flight condition analysis based on the nonlinear EOM. Linearization of Equation of motion (EOM) for a given trimmed flight condition. Transfer-function representations of the linear EOM. Aircraft control analysis based on the linear EOM.

### **Aircraft Structure Analysis**

Review of concepts of Energy Methods of Structural analysis, Bending of Thin Plates; Bending Shear and Torsion of Open and Closed Thin-walled Tubes, Stress Analysis of Aircraft Components; Structural idealization Method; Multi cell tubes; Tapered Beams, Introduction of Airworthiness.

### **Mechatronics**

Basic electronics, connectivity between computer and electromechanical systems, hydraulic systems, pneumatic systems, analysis and design of those systems.

### **Aircraft Design**

Aerodynamics, aircraft structures, performance, stability and controls, sizing, drawing, regulation, component & details design, construction, cost management, ground & flight testing, maintenance & repairs, propulsion & A/C systems.

### **Space Systems Design**

Space mission design, space environment, spacecraft sizing, Design of spacecraft subsystems, Launch systems, spacecraft testing, cost estimation.

### **Mechanics of Flight**

Equation of motion for static performance, aircraft performance in steady flight and accelerated flight, static stability and control, aircraft equation of motion, longitudinal motion, lateral motion.

### **Mechanics of Spaceflight**

Orbit equation, orbit types, orbital maneuvers, position and velocity in orbits, time in orbits, interplanetary transfer, introductory spacecraft systems.

### **Ship Hydrostatics and Stability**

Ship displacement, volume displacement, ship buoyancy, fresh water allowance, statical stability, Initial metacentric height, test of ship inclination, angle of list, angle of loll, curves of statical stability, dynamic stability, effect of movement of center of gravity, loss of metacentric height, effect of slack tanks, trim, longitudinal stability, loss of intact buoyancy, effect of flooding on stability, IMO recommendations on stability.

### **Ship Strength**

Quasi-static analysis of hull preliminary response; introduction to the probabilistic approach and strength of plate structures and ship structural components; combined stresses and failure theories; framing systems; brittle fracture and fatigue modes; structural detail; midship section synthesis, including classification society rules and techniques of stress superposition, material and fabrication consideration.

### **Shipbuilding Engineering**

Ship type; shipbuilding materials and material testing; classification societies and related regulation; welding and cutting processes in shipbuilding; classification society weld testing; fabrication of main ship structural items; keel and bottom construction; shell

plating, framing systems and decks; bulkheads and pillars; superstructures; etc.; fabrication of minor ship structural items; pumping and piping systems; ventilation, refrigeration and insulation; shipbuilding process; shipyard layout and facilities; shipbuilding quality control; shipyard management and organization; industrial and psychology.

#### **Food Product Conveying Equipment Design**

Adjusting and installing of food product conveying equipment; designing of belt, chain, bucket, pneumatic, roller and hanging rails conveyor.

#### **Hygienic and Sanitary Design for Plant**

Introduction to sanitary design of building and grounds, facilities, and equipment; material selection, sanitary best practices; microorganism, pest, and allergen control; chemical and physical hazard control; biofilm; cleaning and agents; cleaning and sanitizing method; handling of waste and waste containers; verification of sanitation; management of sanitation operation.

#### **Safety of Motor Vehicle**

Mechanical characteristics of pneumatic tires; hydroplaning of pneumatic tires; force distribution during acceleration and braking performance of vehicles; energy and thermal requirement of brakes; turning performance; directional and stability control; vehicle collision; crash protection and energy absorption.

#### **Agricultural Tractor Engineering**

Types and basic structure of tractors, mechanics of tractor chassis, stability, transmission, hitching and hydraulic system, traction and traction aids, safety operation, tractor test, maintenance and design, tractor operating cost.

#### **Agricultural Machinery**

Power machine for agricultural production, design principle of agricultural machinery operation, equipment setup and maintenance such as tillage equipment, planting and fertilizing equipment, cultivating equipment, sprayer, harvester, combine harvester, milling machine and dryer.

#### **Vehicle System Design**

Vehicle design concept; Principle in vehicle structure, chassis, power train and vehicle ergonomic design. A practical interesting automotive system design project assigned by the instructor; the project must be completed within one semester; a complete written design report and presentation is required. CAD and CAE are used in design and analyze in the assigned project.

## ๔ สาขาวิศวกรรมไฟฟ้า

## วิชาพื้นฐานทางวิศวกรรม

งานไฟฟ้ากำลังและงานไฟฟ้าสื่อสาร
๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Electric Circuits
๖ Engineering Electronics
๗ Electromagnetic Fields
๘ Control Systems

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

## วิชาเฉพาะทางวิศวกรรม

งานไฟฟ้ากำลัง	งานไฟฟ้าสื่อสาร
๑ Electrical Instruments and Measurements	๑ Electrical Instruments and Measurements
๒ Electrical Machines	๒ Principle of Communication
๓ Electrical System Design	๓ Data Communication and Networking
๔ Electrical Power System	๔ Digital Communication
๕ Power Electronics	๕ Communication Network and Transmission Lines
๖ High Voltage Engineering / Electrical Safety / Electrical Engineering Materials	๖ Optical Communication / Mobile Communication
๗ Power System Protection / Energy Conservation and Management / Sensors & Transducers	๗ Microwave Engineering / Digital Signal Processing
๘ Power Plants and Substations / Renewable Energy / Electric Drives	๘ Antenna Engineering / Broadband Communication

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีหน่วยกิตรวมไม่น้อยกว่า ๒๔ หน่วยกิต

(๒) รายวิชาในกลุ่มที่ ๑-๖ ให้เลือกกลุ่มละ ๑ วิชา ส่วนรายวิชาในกลุ่มที่ ๗ และ ๘ ให้เลือก ๒ วิชา โดยจะเลือกจากกลุ่มใดกลุ่มหนึ่งหรือทั้งสองกลุ่มก็ได้

(๓) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๔) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

**เนือหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมไฟฟ้า**

**งานไฟฟ้ากำลังและงานไฟฟ้าสื่อสาร**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Electric Circuits**

Circuit elements; node and mesh analysis; circuit theorems; resistance, inductance, and capacitance; first and second order circuits; phasor diagram; AC power circuits; three-phase systems.

**๖ Engineering Electronics**

Semiconductor devices; current-voltage and frequency characteristics; analysis and design of diode circuits; analysis and design of BJT, MOS, CMOS and BiCMOS transistor circuits, operational amplifier and its applications, power supply module.

**๗ Electromagnetic Fields**

Electrostatic fields; conductors and dielectrics; capacitance; convection and conduction currents; resistance, magnetostatic fields; magnetic materials; inductance, time-varying electromagnetic fields; Maxwell's equations.

**๘ Control Systems**

Mathematical models of systems; transfer function; system models on time domain and frequency domain; dynamic models and dynamic responses of systems; first and second order systems; open-loop and closed-loop control; feedback control and sensitivity, types of feedback control; concepts and conditions of system stability, methods of stability test.

**เนื่อหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมไฟฟ้า**

**งานไฟฟ้ากำลัง**

**๑ Electrical Instruments and Measurements**

Units and standard of electrical measurement; instrument classification and characteristics; measurement analysis; measurement of DC and AC current and voltage using analog and digital instruments; power, power factor, and energy measurement; measurement of resistance, inductance, capacitance; frequency and period/time-interval measurement; noises; transducers; calibration.

**๒ Electrical Machines**

Magnetic circuits; principles of electromechanical energy conversion; energy and co-energy in magnetic circuits; single phase and three phase transformers; principles of rotating machines; DC machines; AC machines construction; synchronous machines; single phase and three phase induction machines; protection of machines.

**๓ Electrical System Design**

Basic design concepts; codes and standards; power distribution schemes; electrical wires and cables; raceways; electrical equipment and apparatus; load calculation; power factor improvement and capacitor bank circuit design; lighting and appliances circuit design; motor circuit design; load, feeder, and main schedule; emergency power systems; short circuit calculation; grounding systems for electrical installation.

**๔ Electrical Power System**

Electrical power system structure; AC power circuits; per unit system; generator characteristics and models; power transformer characteristics and models; transmission line parameters and models; cable parameters and models; fundamental of load flow; fundamental of fault calculation.

**๕ Power Electronics**

Characteristics of power electronics devices; principles of power converters - AC to DC converter, DC to DC converter, AC to AC converter, DC to AC converter.

**๖ High Voltage Engineering / Electrical Safety / Electrical Engineering Materials**

**High Voltage Engineering**

Uses of high voltage and overvoltage in power systems; generation of high voltage for testing; high voltage measurement techniques; electric field stress and insulation techniques, breakdown of gas; liquid and solid dielectric; high voltage testing techniques; lightning and protection; insulation coordination.

**Electrical Safety**

Electrical Hazards and safety measures; causes of electrical accidents and injuries; electric shock; step and touch potentials; electrostatic discharge (EDS); electrical arc flash and protection; electrical isolation; practical grounding, bonding and shielding; electrical safety testing; circuit protection devices; electrical safety guidance for low-voltage and high-voltage systems; electrical safety in the workplaces.

### **Electrical Engineering Materials**

Structure of materials; electrical properties of materials; magnetic properties of materials; electrical conductors; Introduction to semiconductor devices; superconductivity; solid, liquid and gas dielectrics; applications of materials in electrical power.

### **๗ Power System Protection / Energy Conservation and Management / Sensors & Transducers**

#### **Power System Protection**

Fundamental of protection practices; instrument transformer and transducers; protection devices and protection systems; overcurrent and earth fault protection; differential protection; transmission line protection by distance relaying; transmission line protection by pilot relaying; motor protection; transformer protection; generator protection; bus zone protection; introduction to digital protection devices.

#### **Energy Conservation and Management**

Fundamental of energy efficiency; principle of energy efficiency in building and industry; load management; laws and regulations of energy conservation; energy management and analysis in building and industrial; technical aspects to use energy efficiently in lighting systems, heating and ventilating and air-conditioning (HVAC) systems, industrial motor; co-generation; energy conservations and economic analysis.

#### **Sensors & Transducers**

Introduction to measurement and control devices; analog and digital transducers; pressure measurement techniques; differential pressure transmitter; fluid flow measurement includes primary meters, secondary meters and special methods; measurement of temperature includes non-electric methods, electric methods and radiation method; types of liquid level measurement. direct liquid level measurement, indirect liquid level measurement includes hydrostatic pressure methods, electrical methods and special methods; conventional controller.

### **๘ Power Plants and Substations / Renewable Energy / Electric Drives**

#### **Power Plants and Substations**

Load curve; diesel power plant; steam power plant; gas turbine power plant; combined cycle power plant; hydro power plant; nuclear power plant; renewable energy sources; type of substation; substation equipment; substation layout; substation automation, lightning protection for substation; grounding systems.

#### **Renewable Energy**

Introduction to energy systems and renewable energy resources; potential of renewable resources; difference of conventional and renewable energy technologies; renewable technologies such as solar, wind, biomass, geothermal, biogas, municipal solid waste, wave energy, fuel cell; energy storages; laws, regulations, and policies of renewable energy; economics aspects



## Electric Drives

Electric drive components, load characteristics, operating region of drives, braking methods of motors, power transmission and sizing, torque-speed characteristics of electric motors, DC motor drives, AC motor drives, servo drives systems, applications of drives in industrial automation.

**เนื่อหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมไฟฟ้า**

**งานไฟฟ้าสื่อสาร**

**๑ Electrical Instruments and Measurements**

Units and standard of electrical measurement; instrument classification and characteristics; measurement analysis; measurement of DC and AC current and voltage using analog and digital instruments; power, power factor, and energy measurement; measurement of resistance, inductance, capacitance; frequency and period/time-interval measurement; noises; transducers; calibration.

**๒ Principle of Communication**

Communication models, wire/cable and wireless/radio; Introduction to signal and system; spectrum of signal and applications of Fourier series and transform; analog modulation, AM, DSB, SSB, FM, NB/WBFM, PM; noises in analog communication; binary baseband modulation; Nyquist's sampling theory and quantization; pulse analog modulation, PCM, DM; multiplexing techniques; introduction to transmission lines, radio wave propagation, microwave components and communication, satellite communications, optical communication.

**๓ Data Communication and Networking**

Introduction to data communications and networks; layered network architecture; point-to-point protocols and links; delay models in data networks; medium-access control protocols; flow control; error control; local area network; switching network; routing in data networks; network security; cloud network, architecture and system; standards.

**๔ Digital Communication**

Review of probability and random process; signal space; minimum Nyquist bandwidth; signal detections; AWGN, digital modulation techniques, sigma-delta, performance analysis; synchronization; equalization; introduction of information theory; source coding; channel coding; multichannel and multicarrier systems; spread spectrum techniques; multipath fading channels.

**๕ Communication Network and Transmission Lines**

Wire and wireless communication; wire communication network; Y, Z, F, G, H matrix, relation; connection and basic circuits, network transformation, transmission quantities, signal transmission circuit techniques, wave filters, attenuator, impedance matching, transmission line theory, equation, solution for low, medium, high frequencies, primary and secondary constant; incident and reflected waves, standing wave ratio, line characteristics for open, short, terminated load, lossless, and lossy lines; reflections in time domain, bounce diagrams, near-end and far-end crosstalk, differential signaling, composite line, types of cable, and unshielded twisted pair, coaxial cable; current cable standards.

**๖ Optical Communication / Mobile Communication**

**Optical Communication**

Cylindrical dielectric waveguides and propagating conditions; structure and types of optical fiber; optical fiber parameters; optical fiber production; optical cable types; optical transmitters; optical receivers; signal degradations, attenuation and dispersion in fiber link; optical

repeaters and amplifiers; link budget calculation; multiplexing in optical link system; introduction to FTTX.

### **Mobile Communication**

Wireless communication system; theory, principle of mobile communication system; characteristic and impact of radio propagation; modulation techniques; speech coding; diversity channel coding; multiplexing technique; interconnection components for mobile communication system; standards of current mobile communication, ๓G, ๔G, ๕G and beyond; cellular systems: multiple access and interference management, capacity of wireless channels, multiuser capacity; MIMO system.

### **๗ Microwave Engineering / Digital Signal Processing**

#### **Microwave Engineering**

Review of Maxwell's equations, plane waves; microwave transmission lines and waveguides; microwave network analysis; impedance and equivalent voltage and current; the s-matrix; signal flow graphs, impedance matching and tuning, microwave resonators; power dividers and directional couplers; microwave filters; point-to-point microwave link; radar system; microwave propagation; basic of microwave measurement; applications.

#### **Digital Signal Processing**

Continuous-time and discrete-time signals, spectral analysis; decimation and interpolation; sampling rate conversion; DFT; probabilistic methods in DSP; design of FIR, IIR digital filters, multirate systems and filter Banks; Discrete Wavelet Transform; introduction to some DSP applications such as image processing, speech and audio processing, array processing and further current applications.

### **๘ Antenna Engineering / Broadband Communication**

#### **Antenna Engineering**

Basic definitions and theory; isotropic point source; power and field patterns; directivity and gain; efficiency, polarization; input impedance and bandwidth; Friis transmission equation, radiation from current elements; ground effects; radiation properties of wire antenna; array antenna; Yagi-Uda antenna and log-periodic antenna; aperture antenna; microstrip antenna; modern antenna for current applications; antenna characteristics measurement.

#### **Broadband Communication**

Principles of broadband communication networks for switching telephone system, VoIP telephone, WAN infrastructure; ATM, VPN, FDDI, DSL and current techniques; Internet, intranet; SDH, traffic engineering and QoS; FITH, WLANS, PON DWDM network; theory of power line communications (PLC) for narrowband, broadband communications, standards of PLC-based Networking.

## ๕ สาขาวิศวกรรมอุตสาหกรรม

## วิชาพื้นฐานทางวิศวกรรม

๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Engineering Statistics / Probability and Statistics
๖ Manufacturing Processes
๗ Thermodynamics / Thermodynamics of Materials / Thermofluids
๘ Fundamental of Electrical Engineering

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สาขาวิศวกรรมจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สาขาวิศวกรรมจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

## วิชาเฉพาะทางวิศวกรรม

กลุ่มอุตสาหกรรม	กลุ่มวัสดุ
๑ Safety Engineering	๑ Safety Engineering
๒ Industrial Plant Design	๒ Industrial Plant Design
๓ Production Planning and Control	๓ Production Planning and Control
๔ Quality Control	๔ Quality Control
๕ Industrial Work Study	๕ Mechanical Behavior of Materials
๖ Operations Research	๖ Deterioration of Materials
๗ Engineering Economy	๗ Materials Characterization
๘ Maintenance Engineering	๘ Materials Selection and Design
กลุ่มการผลิต	กลุ่มโลจิสติกส์
๑ Safety Engineering	๑ Safety Engineering
๒ Industrial Plant Design	๒ Industrial Plant Design
๓ Production Planning and Control	๓ Production Planning and Control
๔ Quality Control	๔ Quality Control
๕ Tool Engineering	๕ Inventory and Warehouse Management
๖ Machine Tools	๖ Logistics and Supply Chain Management
๗ Forming Processes	๗ Transportation and Distribution
๘ Automation and Control Systems	๘ Material handling System Design

กลุ่มเมคคาทรอนิกส์
๑ Safety Engineering
๒ Industrial Plant Design
๓ Production Planning and Control
๔ Quality Control
๕ Manufacturing Automation
๖ Industrial Robotics and Machine Vision
๗ Computer Systems and Interfacing
๘ Modeling and Control Systems

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหารายวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

(๔) การจัดการเรียนการสอนต้องมีปฏิบัติการวิศวกรรมพื้นฐานและวิศวกรรมหลักเฉพาะสาขา เพื่อให้สอดคล้องกับรายวิชาในหลักสูตร ดังนี้

- (ก) ปฏิบัติการกระบวนการผลิตพื้นฐาน
- (ข) ปฏิบัติการวิศวกรรมเครื่องกล
- (ค) ปฏิบัติการวิศวกรรมไฟฟ้า
- (ง) ปฏิบัติการวิศวกรรมอุตสาหกรรม

**เนื่อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมอุตสาหกรรม**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Engineering Statistics / Probability and Statistics**

Probability theory; random variables; statistical inference; analysis of variance; regression and correlation; using statistical methods as the tool in problem solving.

**๖ Manufacturing Processes**

Theory and concept of manufacturing processes such as casting, forming, machining and welding; material and manufacturing processes relationships; fundamental of manufacturing cost.

**๗ Thermodynamics / Thermodynamics of Materials / Thermofluids**

**Thermodynamics**

First law of thermodynamics; second law of thermodynamics and Carnot cycle; energy; entropy; basic heat transfer and energy conversion.

**Thermodynamics of Materials**

First and second laws of thermodynamics. Criteria for equilibria in constant pressure processes. Free energy as a function of temperature, pressure and chemical potential. Equilibrium in gas mixtures. Equilibrium between condensed phases and gas phases. Free energy diagram. Solution behavior.

### **Thermofluids**

Fundamental concepts in thermodynamics. The first and second law of thermodynamics. Basic concepts and basic properties of fluids. Fundamentals of fluid statics. Fundamentals of fluid dynamics. Characteristics of fluids such as laminar and turbulent flows.

### **⚡ Fundamental of Electrical Engineering**

Basic DC and AC circuit analysis; voltage; current and power; transformers; introduction to electrical machinery; generators, motors and their uses; concepts of three-phase systems; method of power transmission; introduction to some basic electrical instruments.

## เนื้อหารายวิชาเฉพาะทางวิศวกรรม สาขาวิศวกรรมอุตสาหกรรม

### อุตสาหกรรม

#### ๑ Safety Engineering

Study of loss prevention principles; design, analysis, and control of workplace hazards, human element; system safety techniques; principles of safety management; and safety Laws.

#### ๒ Industrial Plant Design

Introduction to plant design, preliminary analysis of plant design, layout and facilities planning; material handling; nature of plant layout problems; plant location; product analysis; basic types of layout service and auxiliary functions.

#### ๓ Production Planning and Control

Introduction to production systems; forecasting techniques; inventory management; production planning; cost and profitability analysis for decision making; production scheduling; production control.

#### ๔ Quality Control

Quality control management, quality control techniques; engineering reliability for manufacturing.

#### ๕ Industrial Work Study

Working knowledge of the time and motion study; practices and procedures including application of principles of motion economy; use of flow process charts and diagram, Man-Machine charts, micro-motion study, time formulas, work sampling, performance rating, standard data systems and use of equipment related to the work.

#### ๖ Operations Research

An introduction to the methodology of operations research in modern industrial engineering problem solving, emphasis is made on the use of mathematical models, linear programming, transportation model, game theory, queuing theory, inventory model and simulation in decision making process.

#### ๗ Engineering Economy

Methods of comparison; depreciation, evaluation of replacement, risk and uncertainty, estimating income tax consequences.

#### ๘ Maintenance Engineering

Industrial maintenance and Total Productive Maintenance(TPM) concepts, Failure statistics, reliability, maintainability and availability analysis, Lubrication, preventive maintenance systems and condition monitoring technologies, Maintenance control and work order systems, Maintenance organization, personnel and resources, Computerized maintenance management systems (CMMS), Life cycle management, Maintenance reports and key performance indexes, Maintenance system development.



## **วัสดุ**

### **๑ Safety Engineering**

Study of loss prevention principles; design, analysis, and control of workplace hazards, human element; system safety techniques; principles of safety management; and safety Laws.

### **๒ Industrial Plant Design**

Introduction to plant design, preliminary analysis of plant design, layout and facilities planning; material handling; nature of plant layout problems; plant location; product analysis; basic types of layout service and auxiliary functions.

### **๓ Production Planning and Control**

Introduction to production systems; forecasting techniques; inventory management; production planning; cost and profitability analysis for decision making; production scheduling; production control.

### **๔ Quality Control**

Quality control management, quality control techniques; engineering reliability for manufacturing.

### **๕ Mechanical Behavior of Materials**

Elasticity and viscoelasticity, plasticity, imperfections: point, line defects, interfacial, volumetric defects. Macroscopic aspects of fracture, creep and fatigue. Mechanical testing.

### **๖ Deterioration of Materials**

Deterioration of metal, ceramic, polymer and composite: corrosion, chemical deterioration, mechanical deterioration, and thermal degradation.

### **๗ Materials Characterization**

Basic chemical analysis and spectroscopic techniques. Surface analysis by optical microscope and electron microscopes. Crystal structure analysis. Thermal analysis.

### **๘ Materials Selection and Design**

Selection of materials for engineering systems. Materials selection chart. Materials selection by multi-constraints process selection. Fabrication process selection.

## **การผลิต**

### **๑ Safety Engineering**

Study of loss prevention principles; design, analysis, and control of workplace hazards, human element; system safety techniques; principles of safety management; and safety Laws.

### **๒ Industrial Plant Design**

Introduction to plant design, preliminary analysis of plant design, layout and facilities planning; material handling; nature of plant layout problems; plant location; product analysis; basic types of layout service and auxiliary functions.

### **๓ Production Planning and Control**

Introduction to production systems; forecasting techniques; inventory management; production planning; cost and profitability analysis for decision making; production scheduling; production control.

### **๔ Quality Control**

Quality control management, quality control techniques; engineering reliability for manufacturing.

### **๕ Tool Engineering**

Mechanical devices to support for manufacturing to desired position, including fixed position and moving in desired pathway, to assist in cutting, measuring, assembling, welding processes or handling equipments.; tools designed from work piece dimensions and their tolerances to avoid errors of dimensions and shape tolerances; stacking tolerances; selections and calculations of various mechanical components to use for force transmissions e.g. wedge effect, cams, screws, toggles etc; complete samples such as jigs and fixture.

### **๖ Machine Tools**

Types of machine tools and their applications i.e. machine tools for casting, metal forming, material removal processes and specialized machine tools for other specific tasks; structure of machine tools; machine drives and transmission units; linear and rotary guides and bearings; machine tools set-up; machine tools control systems i.e. CNC, PLC

### **๗ Forming Processes**

Material properties for metal forming and plastic forming; sheet metal forming; bulk forming; fundamental of metal forming processes; forging, rolling, extrusion, drawing; powder metallurgy, polymer, ceramic and plastic injection processes; factors and tools involving metal forming and plastic injection processes.

### **๘ Automation and Control Systems**

Fundamental of control techniques and their applications: mechanical control, electrical control, pneumatics controls, hydraulics control; feedback control; PLC; sensor: analog, binary, and digital; CNC machine tools; flexible manufacturing; industrial robots.

## โลจิสติกส์

### ๑ Safety Engineering

Study of loss prevention principles; design, analysis, and control of workplace hazards, human element; system safety techniques; principles of safety management; and safety Laws.

### ๒ Industrial Plant Design

Introduction to plant design, preliminary analysis of plant design, layout and facilities planning; material handling; nature of plant layout problems; plant location; product analysis; basic types of layout service and auxiliary functions.

### ๓ Production Planning and Control

Introduction to production systems; forecasting techniques; inventory management; production planning; cost and profitability analysis for decision making; production scheduling; production control.

### ๔ Quality Control

Quality control management, quality control techniques; engineering reliability for manufacturing.

### ๕ Inventory and Warehouse Management

Guidelines for management of warehouse and distribution center, trend, changes and opportunity, role of warehouse in supply chain, warehouse design and location selection, warehouse and distribution center layout, flow of material planning, simulation model for analysis and design of warehouse and distribution network, economic factor determination, role of warehouse and distribution center for both domestic and foreign, shelves design, logistics information system management of warehouse, risk Management, safety in warehouse, transportation with warehouse activity , case study

### ๖ Logistics and Supply Chain Management

Principle of logistics and supply chain management, the importance of logistics and supply chain management on economic and corporation systems, the role of industrial logistics on supply chain, computer and information technology for logistics, logistics and supply chain planning, the importance of customer service, inventory management, transportation, packaging, purchasing in logistics and supply chain operation, global trend of logistics and supply chain.

### ๗ Transportation and Distribution

Study and analysis of transportation systems. land transportation, airfreight, marine transportation. Forecasting of traveling demand, Analysis of different factors influencing transportation systems, Traffic flow density. Decision making for traveling optimization, Simulation model for studying the behavior of transportation systems, planning of developing systems and transportation routes, case study.

## ๘ Material handling System Design

Principles of material handling system design, Problem analysis and selection of handling method, Design of belt conveyor, tray conveyer, continuous-flow conveyer, bucket elevator, screw conveyer, vibrating tray conveyors, trolley conveyors, roller conveyors, and pneumatic conveyors.

## เมคคาทรอนิกส์

### ๑ Safety Engineering

Study of loss prevention principles; design, analysis, and control of workplace hazards, human element; system safety techniques; principles of safety management; and safety Laws.

### ๒ Industrial Plant Design

Introduction to plant design, preliminary analysis of plant design, layout and facilities planning; material handling; nature of plant layout problems; plant location; product analysis; basic types of layout service and auxiliary functions.

### ๓ Production Planning and Control

Introduction to production systems; forecasting techniques; inventory management; production planning; cost and profitability analysis for decision making; production scheduling; production control.

### ๔ Quality Control

Quality control management, quality control techniques; engineering reliability for manufacturing.

### ๕ Manufacturing Automation

Basic principle of automation systems in manufacturing; principle operation of systems and components used in automation systems, including pneumatic and hydraulic control in a manufacturing process; circuit diagram design based on Programmable Logic Controller (PLC); numerical control machine tools compared to manual and automatic control; system design automation by applying the relevant component such as automated assembly systems, Flexible Manufacturing systems (FMS) and so on.

### ๖ Industrial Robotics and Machine Vision

Fundamental of robot technology; history of robotics; classification of robots; introduction to industrial robotics; robot physical configuration; other technical features; applications for industrial robots; basic robot motion; manipulator; types of drive systems; motion control of industrial robotics; programming the robot and robot programming language; end effector; gripper selection and design; sensors in robotics; robot motion analysis; introduction to manipulator kinematics; robot vision systems, machine vision; acquisition of images; lighting techniques; image processing and analysis; image-processing techniques, image analysis; machine vision technique (๓D); robot cell design and control; hardware interfacing; graphical simulation of robotic workcell; robot applications in manufacturing.

### ๗ Computer Systems and Interfacing

Micro-computer hardware; CPU, bus, memory unit, input and output units; interfacing technique and control program for interfacing to peripheral devices; software design; real time and programming; control program to microcomputer systems; high level

language programming; pipelining memory hierarchy and control, input/output; superscalar and parallel processors; microcomputer applications in measurement systems and control.

### ๘ Modeling and Control Systems

Introduction to control systems; mathematical model of systems; transfer function block diagram; system response; characteristic of control systems; stability analysis of control systems in time-domain and frequency domain; design of feedback control systems based on compensation PID controllers; control system analysis based on state variables; system simulation using computer software.

## ๖ สาขาวิศวกรรมสิ่งแวดล้อม

### วิชาพื้นฐานทางวิศวกรรม

๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Fluid Mechanics/ Hydraulics
๖ Strength of Materials / Surveying / Hydrology
๗ Chemistry for Environmental Engineering / Biology for Environmental Engineering
๘ Environmental Unit Operations / Environmental Unit Processes / Biological Unit Processes

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

### วิชาเฉพาะทางวิศวกรรม

๑ Water Supply Engineering / Water Works Design / Advanced Water Treatment
๒ Wastewater Engineering / Wastewater Engineering Design / Industrial Water Pollution Control / Advanced Wastewater Treatment
๓ Solid Waste Engineering
๔ Air Pollution Control / Design of Air Pollution Control System
๕ Building Sanitation / Design of Sewerage
๖ Environmental System and Management / Environmental Impact Assessment
๗ Hazardous Waste Management / Hazardous Waste Treatment
๘ Environmental Health Engineering / Industrial Safety Management / Environmental Law / Public Health Engineering / Water Resource Management Environment and Energy / Computer Application in Environmental Engineering Construction Management for Environmental Engineering / Environmental Modeling / Noise and Vibration Control

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีหน่วยกิตรวมไม่น้อยกว่า ๒๔ หน่วยกิต

(๒) รายวิชาในกลุ่มที่ ๑-๖ ให้เลือกกลุ่มละ ๑ วิชา ส่วนรายวิชาในกลุ่มที่ ๗ และ ๘ ให้เลือก ๒ วิชา โดยจะเลือกจากกลุ่มใดกลุ่มหนึ่งหรือทั้งสองกลุ่มก็ได้

(๓) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๔) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหาวิชานั้นๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

**เนื้อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมสิ่งแวดล้อม**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Fluid Mechanics / Hydraulics**

**Fluid Mechanics**

Properties of fluid, fluid static; momentum and energy equations; equation of continuity and motion; similitude and dimensional analysis; steady incompressible flow.

**Hydraulics**

Properties of fluids; static, dynamics and kinematics of fluid flow; energy equation in a steady flow; momentum and dynamic forces in fluid flow; similitude and dimensional analysis; flow of incompressible fluid in pipes; open - channel flow; fluid flow measurements; unsteady flow problems.

**๖ Strength of Materials / Surveying / Hydrology**

**Strength of Materials**

Forces and stresses; stresses and strains relationship; stresses in beams, shear force and bending moment diagrams; deflection of beams, torsion; buckling of columns; Mohr's circle and combined stresses; failure criterion.



### **Surveying**

Introduction to surveying work; basic field works, leveling; principles and applications of theodolites; distance and direction measurements; errors in surveying, acceptable error, data correction, triangulation; precise determination of azimuth; precise traverse plane coordinate systems, precise leveling; topographic survey; map plotting.

### **Hydrology**

Hydrologic cycles; precipitation; infiltration; runoff; rain and river gauging; hydrographs; reservoirs; evaporation; evapotranspiration; flood forecasting; flood routing; groundwater; measurement of hydrologic and meteorological variables.

## **๗ Chemistry for Environmental Engineering / Biology for Environmental Engineering**

### **Chemistry for Environmental Engineering**

Chemical and physical characteristics of water and wastewater, methods for determination and application of data to environmental engineering practice; sample collection and preservation; laboratory analysis of water; determinations of solids, DO, BOD, COD, nitrogen, phosphorus.

### **Biology for Environmental Engineering**

Cell and its structure, principles of bacteriology, methods of collection and bacteriological examination of water and wastewater, actions of enzymes as related to stabilization of organic matter, biodegradation of organic compounds, fundamental concepts related to energy, food chain, productivity and limiting factors, basic concept of ecology, biota dynamics in wastewater treatment environments.

## **๘ Environmental Unit Operations / Environmental Unit Processes / Biological Unit Processes**

### **Environmental Unit Operations**

Fundamentals of physical unit operations in water and wastewater treatment: mixing, sedimentation, flotation, filtration, and equalization; aeration and mass transfer operations: absorption and adsorption.

### **Environmental Unit Processes**

Fundamentals of process analysis; reactors: plug flow and continuous stirred tank reactors; chemical and biological unit processes in water and wastewater treatment: neutralization, ion exchange disinfection and biological suspended - growth and attached - growth treatment systems; kinetics.

### **Biological Unit Processes**

Fundamentals of biological unit processes in wastewater treatment; reactor engineering; kinetics of biochemical systems; modeling of biological reactor; control parameters for biological suspended and attached growth treatments.

**เนื้อหารายวิชาวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมสิ่งแวดล้อม**

**๑ Water Supply Engineering/Water Works Design/ Advanced Water Treatment**

**Water Supply Engineering**

Importance of water; nature and sources of water; water demand and requirement; raw water sources; surface and groundwater quality and standards; water treatment processes: aeration, coagulation and flocculation, sedimentation, filtration and disinfection.

**Water Works Design**

Water demand estimation; design of raw water intake and pumping station; rapid and slow mixing unit; sedimentation unit; filtration unit; disinfection unit; design of distribution systems.

**Advanced Water Treatment**

Principles of advanced water treatment; stripping; ion exchange; adsorption; membrane processes; selection of treatment alternatives.

**๒ Wastewater Engineering / Wastewater Engineering Design / Industrial Water Pollution Control / Advanced Wastewater Treatment**

**Wastewater Engineering**

Wastewater characteristics; wastewater flow rates and measurement; wastewater treatment objectives and effluent standards; physical treatment; chemical treatment; biological treatment and sludge treatment and disposal.

**Wastewater Engineering Design**

Design of combined and separated sewer; pump and pumping stations; design of facilities for physical, chemical and biological treatment of wastewater; disposal of sludge.

**Industrial Water Pollution Control**

Production processes of major industries and their wastewater characteristics; wastewater minimization and clean technology; treatment technology; laws and regulations.

**Advanced Wastewater Treatment**

Principles of advanced wastewater treatment; removal of nitrogen and phosphorus; removal of toxic compounds; natural treatment systems.

**๓ Solid Waste Engineering**

Generation and characteristics of municipal solid wastes; handling at source; collection; transfer and transport; processing and transformation; sanitary landfill.

## ๔ Air Pollution Control / Design of Air Pollution Control Systems

### Air Pollution Control

Types of air pollutants and sources; effects on health and environment; meteorological transport; principles of particulate and gaseous pollutant control; sampling and analysis methods; laws and regulations.

### Design of Air Pollution Control Systems

Principles and design of air pollution control units for particulate and gases; ventilation system design; operation and maintenance.

## ๕ Building Sanitation / Design of Sewerage

### Building Sanitation

Fundamentals of building sanitation; laws and regulations; cold water supply systems; hot water supply systems; soil, waste and vent pipe systems; fire protection systems; site drainage; wastewater treatment and solid waste management for individual building.

### Design of Sewerage

Hydraulics in sewerage systems; estimation of water flow quantity; designs of wastewater collection and storm water drainage systems; components of drainage systems; design of pumping station.

## ๖ Environmental Systems and Management / Environmental Impact Assessment

### Environmental Systems and Management

Concepts of environmental systems and management issues and priorities; standards and criteria setting; indication and indices; information systems; organization; enforcement and economic aspects of environmental control; EMS and ISO; monitoring; pollution prevention; case studies.

### Environmental Impact Assessment

Concepts of impact assessment and methodology; assessments of physical resources, ecological resources, human use values and quality of life values; prevention and mitigation measures; monitoring plan; case studies.

## ๗ Hazardous Waste Management / Hazardous Waste Treatment

### Hazardous Waste Management

Types and characteristics; environmental legislation; risk assessment and management; handling and transportation; treatment processes: incineration, stabilization and solidification, land disposal and site remediation.

### **Hazardous Waste Treatment**

Basic principles of management and treatment of both organic and inorganic hazardous waste; the treatment systems includes physical, chemical, biological, or thermal process as well as final deposition method.

☞ **Environmental Health Engineering / Industrial Safety Management / Environmental Law / Public Health Engineering / Water Resource Management / Environment and Energy / Computer Application in Environmental Engineering / Construction Management for Environmental Engineering / Environmental Modeling / Noise and Vibration Control**

### **Environmental Health Engineering**

Principles of environmental health engineering; community and occupational environments; environmental health standards and requirements; health risk assessment; application of engineering principles in environmental health protection, safety and emergency response.

### **Industrial Safety Management**

Nature of accident in industry and need of accident prevention; planning for safety such as plant layout, machine guarding and maintenance, etc; safety in industry; management of safety program; safety training; case studies in accident analysis.

### **Environmental Law**

Environmental Laws and Standards; Factory Acts; Hazardous Substances Acts; Environmental Regulations and Decrees; Public Health Acts; Implementation and Enforcement; Related International laws and regulations.

### **Public Health Engineering**

Health aspects of environmental quality; some principles of epidemiology with special emphasis on community and occupational environments; environmental health standards and requirements; engineering control of some urban and rural pollution problems; other topics in application of engineering principles in environmental protection.

### **Water Resource Management**

Principles of water resource management; water management in irrigation project;, water resources projects for domestic and industrial uses, urban drainage projects, and for water quality; data measurement and analysis; storage systems; optimization; case studies.

### **Environment and Energy**

Energy resources and utilization; fossil-based energy; environmental impact of mining and fuel processing; air pollution greenhouse gas, and global warming from fuel utilization; energy conservation and renewable energy technologies; hydro energy harnessing and its environmental impact and mitigation; other non-fossil fuel options: biomass, solar, and wind energy.

### **Computer Application in Environmental Engineering**

Introduction to computer as computational aids in environmental engineering analysis; applications of computer to analyze problems in water supply engineering: flows in sewers and water distribution systems, analysis of hydrological problems, hydraulic analysis in water and wastewater treatment plants, designing of water and wastewater treatment units; water management modeling; air pollution management and control computations.

### **Construction Management for Environmental Engineering**

Construction industry for environmental unit processes; principles of management; construction organization; contracts and tendering; planning and control tools; feasibility study; cash-flow analysis; construction laws, regulations, and emission and effluent standards; safety in construction; construction finance and accounting; construction and disputes; arbitration; unit start up and commissioning.

### **Environmental Modeling**

Pollutant transport phenomena: advection, diffusion/dispersion, sediment transport; completely mixed systems; plug-flow systems; advective-dispersive systems; reaction kinetics; equilibrium chemical modeling; mass balance equation for plug-flow systems; Street-Phelps equation; waste load allocations; dissolved oxygen in large rivers and estuaries; eutrophication of lakes; toxic organic chemicals in rivers, estuaries, and lakes; groundwater contamination; atmospheric deposition and biogeochemistry; climate change and general circulation models; global carbon box model.

### **Noise and Vibration Control**

Principles of sound waves; instrumentation; measurement; impact of noise and vibration on human health and environment; laws and regulations; use of acoustic materials and barriers.

## ๗ สาขาวิศวกรรมเคมี

## วิชาพื้นฐานทางวิศวกรรม

๑ Engineering Drawing
๒ Engineering Mechanics
๓ Engineering Materials
๔ Computer Programming
๕ Engineering Statistics / Probability and Statistics / Experimental Design
๖ Chemical Engineering Processes / Chemical Engineering Principle and Calculation
๗ Thermodynamics / Physical Chemistry
๘ Fundamental of Electrical Engineering / Chemical Process Instrumentation

**หมายเหตุ** (๑) วิชาพื้นฐานทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหารายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

## วิชาเฉพาะทางวิศวกรรม

๑ Chemical Engineering Thermodynamics
๒ Fluid flow
๓ Heat Transfer and Mass Transfer
๔ Chemical Engineering Kinetics and Reactor Design
๕ Process Dynamics and Control
๖ Chemical Engineering Plant Design
๗ Safety in Chemical Operation / Environmental Chemical Engineering
๘ Engineering Economy / Chemical Engineering Economics

**หมายเหตุ** (๑) วิชาเฉพาะทางวิศวกรรมต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชาและมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

(๒) เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้

(๓) กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยเทียบเนื้อหารายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้

**เนื้อหารายวิชาพื้นฐานทางวิศวกรรม  
สาขาวิศวกรรมเคมี**

**๑ Engineering Drawing**

Lettering; orthographic projection; orthographic drawing and pictorial drawings, dimensioning and tolerancing; sections, auxiliary views and development; freehand sketches, detail and assembly drawings; basic computer-aided drawing.

**๒ Engineering Mechanics**

Force systems; resultant; equilibrium; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy, impulse and momentum.

หรือ Statics : Force systems; resultant; equilibrium; friction; principle of virtual work, and stability, Introduction to dynamics.

**๓ Engineering Materials**

Study of relationship between structures, properties, production processes and applications of main groups of engineering materials i.e. metals, polymers, ceramics and composites; mechanical properties and materials degradation.

**๔ Computer Programming**

Computer concepts; computer components; Hardware and software interaction; Current programming language; Programming practices.

**๕ Engineering Statistics / Probability and Statistics / Experimental Design**

**Engineering Statistics / Probability and Statistics**

Probability theory; random variables; statistical inference; analysis of variance; regression and correlation; using statistical methods as the tool in problem solving.

**Experimental Design**

Principles of experimental design; randomization; factorial designs; application of statistical technique, analysis techniques and regression; interpretation the analyses.

**๖ Chemical Engineering Processes / Chemical Engineering Principle and Calculation**

**Chemical Engineering Processes**

Studies of production processes in industrial plants; raw materials, energy, industrial equipment, safety and environmental impacts; visit study of related factory.

**Chemical Engineering Principle and Calculation**

Introduction to Chemical Engineering Calculation: stoichiometry and material balance calculation; recycling, bypassing and purging; use of chemical and phase equilibrium data; energy balance.

**๗ Thermodynamics / Physical Chemistry****Thermodynamics**

First law of thermodynamics; second law of thermodynamics and Carnot cycle; energy; entropy; basic heat transfer and energy conversion.

**Physical Chemistry**

The nature of physical chemistry; gases; chemical thermodynamics; the law of chemical thermodynamics; free energy, phase rule, chemical equilibrium; solutions of non-electrolytes and electrolytes; electrochemistry

**๘ Fundamental of Electrical Engineering / Chemical Process Instrumentation****Fundamental of Electrical Engineering**

Basic DC and AC circuit analysis; voltage; current and power; transformers; introduction to electrical machinery; generators, motors and their uses; concepts of threephase systems; method of power transmission; introduction to some basic electrical instruments.

**Chemical Process Instrumentation**

Characteristics, types and limits of measuring instruments used in chemical process industry; temperature, pressure, flow, level, pH, and composition transducers; actuators used in process industries; interfacing components techniques.



**เนือหารายวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมเคมี**

**๑ Chemical Engineering Thermodynamics**

Thermodynamics of multi-component systems and applications for phase equilibrium and chemical reaction equilibrium.

**๒ Fluid Flow**

Physical properties of fluids; fluid static and application; characteristics of fluid flow and momentum transfer including applications; design of unit operations for solid-fluid separations.

**๓ Heat Transfer and Mass Transfer**

**Heat Transfer**

Basic principles and mechanisms for heat transfer; conceptual design of heat transfer equipments.

**Mass Transfer**

Basic principles and mechanisms for mass transfer; conceptual design of mass transfer and simultaneous heat-mass transfer equipments.

**๔ Chemical Engineering Kinetics and Reactor Design**

Application of thermodynamic and kinetic fundamentals to the analysis and design of chemical reactors; type of reactors: single reactor and multiple reactor systems; isothermal and non-isothermal operation: homogeneous reactors and introduction to heterogeneous reactors.

**๕ Process Dynamics and Control**

Mathematical modeling of chemical engineering systems; solution techniques and dynamics of these systems; introduction to automatic control; feedback control concept; stability analysis; frequency response and control system designs; introduction to measurement and control instrument characteristics.

**๖ Chemical Engineering Plant Design**

Conceptual design of chemical plant; general design considerations and selection; process design project of a chemical plant.

**๗ Safety in Chemical Operations / Environmental Chemical Engineering**

**Safety in Chemical Operations**

Principles of safety and loss prevention control; hazard identification and handling including risk assessment; principles of safety management; legislation and safety laws.

**Environmental Chemical Engineering**

Impacts of environmental pollution; environmental quality standards; sources and characteristics of industrial wastes and treatment methods; hazardous wastes and disposal methods.

**↻ Engineering Economy / Chemical Engineering Economics****Engineering Economy**

Methods of comparison; depreciation, evaluation of replacement, risk and uncertainty, estimating income tax consequences.

**Chemical Engineering Economics**

Introduction to general economics; accounting data and financial statements in the chemical industry; economic evaluation in chemical engineering plant design; economic evaluation for alternative selection and investment of chemical process