

## ระเบียบคณะกรรมการสภาวิศวกร

ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม  
ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตร  
ในการประกอบวิชาชีพวิศวกรรมควบคุม  
พ.ศ. ๒๕๕๔

โดยที่เป็นการสมควรกำหนดให้มีระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐานทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม

อาศัยอำนาจตามความในมาตรา ๓๓ (๓) แห่งพระราชบัญญัติวิศวกร พ.ศ. ๒๕๔๒ และข้อ ๘ ของข้อบังคับสภาวิศวกร ว่าด้วยการรับรองปริญญา ประกาศนียบัตร หรือวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๔ ประกอบกับมติที่ประชุมคณะกรรมการสภาวิศวกร ครั้งที่ ๓๙ - ๑๗/๒๕๕๔ เมื่อวันที่ ๑๘ พฤศจิกายน ๒๕๕๔ คณะกรรมการสภาวิศวกรจึงออกระเบียบไว้ ดังต่อไปนี้

ข้อ ๑ ระเบียบนี้เรียกว่า “ระเบียบคณะกรรมการสภาวิศวกร ว่าด้วยวิชาพื้นฐาน ทางวิทยาศาสตร์ วิชาพื้นฐานทางวิศวกรรม และวิชาเฉพาะทางวิศวกรรม ที่สภาวิศวกรจะให้การรับรองปริญญา ประกาศนียบัตร และวุฒิบัตรในการประกอบวิชาชีพวิศวกรรมควบคุม พ.ศ. ๒๕๕๔”

ข้อ ๒ ระเบียบนี้ให้ใช้บังคับตั้งแต่วันถัดจากวันประกาศในราชกิจจานุเบกษาเป็นต้นไป

ข้อ ๓ วิชาพื้นฐานทางวิทยาศาสตร์ ให้เป็นไปตามรายละเอียด สารของวิชา และแผนการจัดการศึกษา ที่กำหนดไว้ในบัญชีหมายเลข ๑ ท้ายระเบียบนี้

ข้อ ๔ วิชาพื้นฐานทางวิศวกรรม ให้เป็นไปตามรายละเอียด สารของวิชา และแผนการจัดการศึกษา ที่กำหนดไว้ในบัญชีหมายเลข ๒ ท้ายระเบียบนี้

ข้อ ๕ วิชาเฉพาะทางวิศวกรรม ให้เป็นไปตามรายละเอียด สารของวิชา และแผนการจัดการศึกษา ที่กำหนดไว้ในบัญชีหมายเลข ๓ ท้ายระเบียบนี้

ประกาศ ณ วันที่ ๓๐ พฤศจิกายน พ.ศ. ๒๕๕๔

เรืองศักดิ์ วัชรพงศ์

นายกสภาวิศวกร

บัญชีหมายเลข ๑  
(ข้อ ๓)  
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  
(ข้อ ๔)  
วิชาพื้นฐานทางวิศวกรรม

รายวิชาสาขาวิศวกรรมโยธา ๘ กลุ่ม

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

รายวิชาสาขาวิศวกรรมเหมืองแร่ ๘ กลุ่ม

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

รายวิชาสาขาวิศวกรรมเครื่องกล ๘ กลุ่ม

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

### รายวิชาสาขาวิศวกรรมไฟฟ้า ๘ กลุ่ม

#### งานไฟฟ้ากำลัง และงานไฟฟ้าสื่อสาร

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

### รายวิชาสาขาวิศวกรรมอุตสาหการ ๘ กลุ่ม

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

### รายวิชาสาขาวิศวกรรมสิ่งแวดล้อม ๘ กลุ่ม

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

## รายวิชาสาขาวิศวกรรมเคมี ๘ กลุ่ม

- ๑ Engineering Drawing
- ๒ Engineering Mechanics
- ๓ Engineering Materials
- ๔ Computer Programming
- ๕ Engineering Statistics หรือ 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 วิชาพื้นฐานทางวิศวกรรมทุกสาขา ต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชา และมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### 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 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.

## ๗ Fluid Mechanics/ Hydraulics & Laboratory

### Fluid Mechanics

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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนื้อหารายวิชาพื้นฐานทางวิศวกรรม

### สาขาวิศวกรรมเหมืองแร่ (งานเหมืองแร่และงานโลหการ)

#### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### 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

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.

## ๘ 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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### 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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### สาขาวิศวกรรมไฟฟ้า

#### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### 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; device current-voltage and frequency characteristics; analysis and design of diode circuits; analysis and design of BJT and MOS transistor circuits; operational amplifier and its applications.

#### ๗ Electromagnetic Fields

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

## ๘ Control Systems

Mathematical models of systems; closed-loop and open-loop control systems; transfer function; signal flow graphs; time-domain and frequency-domain analysis and design of control systems; root locus; Nyquist plots; Bode plots; system stability.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### ๕ Engineering Statistics หรือ 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.

**Themofluids** : 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.

#### ๘ 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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### ๕ 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.



## ৬ 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.

## ৭ 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.

## ৮ 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.

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## เนือหารายวิชาพื้นฐานทางวิศวกรรม

### 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.

หรือ Dynamics : Kinematics and kinetics of particles and rigid bodies; Newton's second law of motion; work and energy; impulse and motion.

#### 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; phase equilibrium diagrams and their interpretation; mechanical properties and materials degradation.

#### ๔ Computer Programming

Computer concepts; computer components; hardware and software interaction; EDP concepts; program design and development methodology; high-level language programming.

#### ๕ Engineering Statistics หรือ Probability and Statistics / Experimental Design

##### Engineering Statistics หรือ 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 three-phase 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, turbidity, and composition transducers; actuators used in process industries; interfacing components techniques.

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บัญชีหมายเลข ๓  
(ข้อ ๕)  
วิชาเฉพาะทางวิศวกรรม

รายวิชาสาขาวิศวกรรมโยธา ๘ กลุ่ม

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

รายวิชาสาขาวิศวกรรมเหมืองแร่ ๘ กลุ่ม

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

รายวิชาสาขาวิศวกรรมเครื่องกล ๘ กลุ่ม

เครื่องกล	เกษตร/เครื่องจักรกลเกษตร
๑ Mechanics of Machinery	๑ Mechanics of Machinery /Theory of Agricultural Machines
๒ Machine Design หรือ Mechanical Design	๒ Machine Design หรือ Mechanical Design / Agricultural Machinery Design
๓ Automatic Control / Digital control / Fluid Power Control / Dynamics Systems and Control	๓ Automatic Control / Digital control / Fluid Power Control / Fluid Power Control for Agricultural Engineering
๔ Mechanical Vibration	๔ Mechanical Vibration/ Vibration for Agricultural Engineering
๕ Internal Combustion Engines / Combustion	๕ Internal Combustion Engines / Combustion/ Internal Combustion Engines for Agricultural systems
๖ Air Conditioning / Refrigeration / Refrigeration and Air Conditioning	๖ Air Conditioning / Refrigeration / Industrial Refrigeration, Freezing, Cold Storage /Refrigeration and Cold Storage Systems
๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design	๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design
๘ Power Plant Engineering /Power Generation and Environment	๘ Power Plant Engineering / Power for Agricultural Systems

ยานยนต์	อาหาร
๑ Mechanics of Machinery / Dynamics of Vehicles	๑ Mechanics of Machinery / Mechanics of Food Machinery
๒ Machine Design หรือ Mechanical Design	๒ Machine Design หรือ Mechanical Design /Design of Food Machinery
๓ Automatic Control/Automotive Control	๓ Automatic Control / Food Process Control
๔ Mechanical Vibration	๔ Mechanical Vibration for Food Engineer
๕ Internal Combustion Engines / Combustion	๕ Internal Combustion Engines / Combustion / Combustion Technology for Food Engineering
๖ Air Conditioning	๖ Refrigeration /Industrial Refrigeration, Freezing, Cold Storage
๗ Heat Transfer	๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design
๘ Power Plant Engineering	๘ Power Systems in Food Industry

เครื่องกลเรือ/ต่อเรือ	อากาศยาน/การบินและอวกาศ	เมคคาทรอนิกส์
๑ Mechanics of Machinery / Ship Dynamics / Ship Buoyancy and Stability	๑ Mechanics of Machinery / Mechanics of Flight	๑ Mechanics of Machinery / Dynamics of Robotics
๒ Machine Design หรือ Mechanical Design / Ship Design	๒ Machine Design /Aircraft Design	๒ Machine Design หรือ Mechanical Design / Mechatronics Design
๓ Automatic Control / Digital control / Fluid Power Control	๓ Automatic Control / Digital control /Automatic Flight Control	๓ Automatic Control / Digital Control / Fluid Power Control
๔ Mechanical Vibration/ Ship vibration	๔ Mechanical Vibration	๔ Mechanical Vibration
๕ Internal Combustion Engines / Combustion	๕ Internal Combustion Engines / Combustion	๕ Internal Combustion Engines / Combustion
๖ Air Conditioning / Refrigeration	๖ Air Conditioning / Aircraft Air Conditioning and Pressurization Systems	๖ Air Conditioning / Refrigeration / Refrigeration and Air Conditioning
๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design	๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design	๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design
๘ Power Plant Engineering / Ship Propulsion and Engines / Ship Resistant and Powering	๘ Aircraft Power Plant / Aerospace Propulsion	๘ Power Plant Engineering

รายวิชาสาขาวิศวกรรมไฟฟ้า ๘ กลุ่ม

งานไฟฟ้ากำลัง		
ไฟฟ้ากำลัง	พลังงาน	ระบบควบคุมและการวัดและเมคคาทรอนิกส์
๑ Electrical Instruments and Measurements	๑ Electrical Instruments and Measurements	๑ Electrical Instruments and Measurements
๒ Electrical Machines	๒ Electrical Machines	๒ Electrical Machines
๓ Electrical System Design	๓ Electrical System Design	๓ Electrical System Design
๔ Electric Power System Analysis	๔ Electric Power System Analysis	๔ Electric Power System Analysis
๕ Power Plant and Substation / Electrical Power Generation, Transmission and Distribution	๕ Thermal Sciences	๕ Electrical Power Generation, Transmission and Distribution
๖ Power System Protection	๖ Distributed Generation Systems	๖ Microprocessors/ Computer Systems and Interfacing
๗ High Voltage Engineering / Electrical Engineering Materials	๗ Renewable Energy	๗ Process Instrumentation/ Industrial Sensors and Control Devices
๘ Power Electronics	๘ Energy Conservation and Management	๘ Instrumentation System Design/Industrial Automation Systems / Electric Drives

งานไฟฟ้าสื่อสาร
๑ Electrical Instruments and Measurements
๒ Principles of Communication
๓ Communication Network and Transmission Lines / Signal and Systems
๔ Digital Communication
๕ Data Communication and Networking
๖ Optical Communication
๗ Microwave Engineering
๘ Antenna Engineering

รายวิชาสาขาวิศวกรรมอุตสาหการ ๘ กลุ่ม

อุตสาหกรรม	วัสดุ
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
การผลิต	โลจิสติกส์
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
เมคคาทรอนิกส์	
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	



### รายวิชาสาขาวิศวกรรมสิ่งแวดล้อม ๘ กลุ่ม

- 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 Systems/ Noise and Vibration Control
- ๕ Environmental Systems and Management / Environmental Impact Assessment
- ๖ Building Sanitation / Design of Sewerage
- 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

### รายวิชาสาขาวิศวกรรมเคมี ๘ กลุ่ม

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

**หมายเหตุ** วิชาเฉพาะทางวิศวกรรมทุกสาขา ต้องมีการเรียนการสอนทั้ง ๘ กลุ่มรายวิชา และมีหน่วยกิตรวมกันไม่น้อยกว่า ๒๔ หน่วยกิต ทั้งนี้ ในกรณีที่กลุ่มรายวิชาใดมีให้เลือกมากกว่า ๑ รายวิชา สภาวิศวกรจะนับให้เพียง ๑ รายวิชาต่อกลุ่ม เท่านั้น

## เนือหารายวิชาเฉพาะทางวิศวกรรม

### สาขาวิศวกรรมโยธา

#### ๑ Structural Analysis

Introduction to structural analysis; reactions, shears and moments in statically determinate structures; graphic statics; influence lines of determinate structures; deflections of determinate structures by methods of virtual work, strain energy and Williot-Mohr diagrams; analysis of statically indeterminate structures by method of consistent deformation, elastic load method, methods of slope and deflection, moment distribution, strain energy; influence line of indeterminate structures; introduction to plastic analysis; approximate analysis; introduction to matrix structural analysis.

#### ๒ Reinforced Concrete Design & Practice

Fundamental behavior in thrust, flexure, torsion, shear, bond and interaction among these forces; design of reinforced concrete structural components by working stress and strength design concepts; 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

The fundamental behaviors and properties, introduction to inspecting and testing of various civil engineering materials, steel and rebar, wood, cement, aggregates and admixtures, fresh and hardened concrete, highway materials, others Civil Engineering materials.

#### ๕ Steel & Timber Design & Practice / Foundation Engineering & Practice

##### Steel & 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 & timber design and detailing

##### Foundation Engineering

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

## Practice

Practice in foundation engineering and detailing.

## ๖ Hydraulic Engineering / Water Resources Engineering

### Hydraulic Engineering

Application of fluid mechanic 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.

### 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

### Highway Engineering

Historical development of highways; highway administration; principles of highway planning and traffic analysis; geometric design and operations; highway finance and economic; flexible and rigid 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.

## ๘ Construction Engineering and Management /Route Surveying /Photogrammetry

### 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.

### 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.

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## เนื้อหารายวิชาเฉพาะทางวิศวกรรม

### 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 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.

### **୬ 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.

### **୭ Mineral Processing II / Separation Technology**

#### **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.

### **୫ 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).

## งานโลหะการ

### 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 Mechanical Behaviour of Materials

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

### ๓ Failure Analysis

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

### ๔ 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.

### ๕ Materials Characterization

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

### ๖ 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.

### ๗ 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.

## ∞ Corrosion of Metals

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

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

## เนื่อหารายวิชาเฉพาะทางวิศวกรรม

### สาขาวิศวกรรมเครื่องกล

#### เครื่องกล

##### ๑ Mechanics of Machinery

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

##### ๒ Machine Design หรือ Mechanical Design

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

##### ๓ Automatic Control / Digital Control / Fluid Power Control / Dynamics of Systems and Control

###### Automatic Control

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

###### Digital Control

Mathematical modeling of engineering systems, principles of feedback control, root locus analysis and design, frequency response design method, discrete time systems and control.

###### Fluid Power Control

Basic fluid mechanics. flow, pressure, energy, basic components, pump, valve, motor, fluid power systems, static and dynamic characteristics, feed back control , sensor, controller, actuator, control action, transfer function, sequence control.

###### Dynamics Systems and Control

Laplace transform, Block diagram and state variable models, Modeling of Mechanical systems, Modeling of electrical systems, Modeling of fluid systems, Modeling of thermal systems, Linear system analysis in the time domain, Linear system analysis in the frequency domain, Basic feedback 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.



## ⌘ Internal Combustion Engines / Combustion

### 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.

## ↪ Air Conditioning / Refrigeration / Refrigeration and Air Conditioning

### 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.

## ↻ Heat Transfer / Heat and Mass Transfer / Thermal System Design

### Heat Transfer

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

### Heat and Mass Transfer

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.

## Thermal System Design

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

## ๘ Power Plant Engineering / Power Generation and Environment

### 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.

## เกษตร / เครื่องจักรกลเกษตร

### ๑ Mechanics of Machinery / Theory of Agricultural Machines

#### Mechanics of Machinery

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

#### Theory of Agricultural Machines

Velocity and acceleration; S, V, A graphs; cams and rolling contact; gear train, static forces and inertia; flywheel and balancing.

### ๒ Machine Design หรือ Mechanical Design / Agricultural Machinery Design

#### Machine Design หรือ Mechanical Design

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

#### Agricultural Machinery Design

Principles of agricultural machine component design, properties of materials, loading on simple machine elements, different types of stress and theories of failure, stress concentrations and fatigue loading, shafts, bearings, joining parts together with bolted joints, riveted connections, welded joints and coupling, power transmission with gear drives, belt drives and chain drives, spring.

### ๓ Automatic Control / Digital Control / Fluid Power Control / Fluid Power Control for Agricultural Engineering

### **Automatic Control**

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

### **Digital Control**

Mathematical modeling of engineering systems, principles of feedback control, root locus analysis and design, frequency response design method, discrete time systems and control.

### **Fluid Power Control**

Basic fluid mechanics. flow, pressure, energy, basic components, pump, valve, motor, fluid power systems, static and dynamic characteristics, feed back control , sensor, controller, actuator, control action, transfer function, sequence control.

### **Fluid Power Control for Agricultural Engineering**

Fluid power in hydraulic and pneumatic equipment; hydraulic and pneumatic equipment used in the systems; hydraulic pumps, air compressor; control valves; hydraulic and pneumatic actuators; motors and control accessories in hydraulic and pneumatic systems; hydraulic systems of tractors; feedback control; sensor, controller, actuator; model of physical systems; transfer function and block diagram; frequency response of systems; sequence control; application in agricultural engineering.

### **⌘ Mechanical Vibration / Vibration for Agricultural Engineering**

#### **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.

#### **Vibration for Agricultural Engineering**

Resonant frequency, free and forced vibration of systems having one and several degrees of freedom, application of unbalanced rotation, vibration measurement systems, reduction and absorption of vibration, continuous vibration systems, effect of vibration on agricultural machine operators, vibration analysis in agricultural machinery, application of vibration on agricultural engineering.

### **⌘ Internal Combustion Engines / Combustion / Internal Combustion Engines for Agricultural systems**

#### **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.

## **↪ Air Conditioning / Refrigeration / Industrial Refrigeration, Freezing, Cold Storage / Refrigeration and Cold Storage Systems**

### **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.

### **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.

## ๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design

### Heat Transfer

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

### Heat and Mass Transfer

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.

### Thermal System Design

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

## ๘ Power Plant Engineering / Power for Agricultural Systems

### 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 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.

## ยานยนต์

## ๑ Mechanics of Machinery / Dynamics of Vehicles

### Mechanics of Machinery

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

### Dynamics of Vehicles

Acceleration and braking performance, road loads, steady-state cornering, ride, steering systems, suspension, tires, and rollover.

## ๒ Machine Design หรือ Mechanical Design

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

## en Automatic Control / Automotive Control

### Automatic Control

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

### Automotive Control

System model, system responses, basics of controls, control system designs, automotive control system design, system model, actuator, sensor and electronic control, automotive control systems.

### ↻ 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.

### ↻ Internal Combustion Engines / Combustion

#### 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.

### ↵ Air Conditioning

Psychrometric 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.

### en Heat Transfer

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

### ↻ 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.

**อาหาร****๑ Mechanics of Machinery / Mechanics of Food Machinery****Mechanics of Machinery**

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

**Mechanics of Food Machinery**

Linkages in food machinery, analysis of velocity and acceleration of moving parts, velocity ratio of gear trains, static and inertia force analyses of linkages and gear trains of machine, balancing of rotating and reciprocating mass.

**๒ Machine Design หรือ Mechanical Design / Design of Food Machinery****Machine Design หรือ Mechanical Design**

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

**Design of Food Machinery**

Fundamentals of mechanical design, theory of failure, properties of simple machine elements, rivet and screw fasteners, shaft spring and conveyor, design of coupling, journal bearing, rolling bearing, welded joints, fundamentals of hygienic design, design project characteristics and food applications.

**๓ Automatic Control / Food Process Control****Automatic Control**

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

**Food Process Control**

Automatic control principles, analysis and modeling of food engineering systems, linear control elements, feedback control, stability and performance analysis, measurement and control instruments, control applications for food processing.

**๔ Mechanical Vibration for Food Engineering**

Harmonic and non-harmonic motions, natural frequencies and modes of vibration, vibrations of single and multi degree-of-freedom systems, method of equivalent systems, vibration control concept, design of vibration systems for applications in food engineering.

## **⌘ Internal Combustion Engines / Combustion / Combustion Technology for Food 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.

### **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.

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

### **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.

### **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.

## **⌘ Heat Transfer / Heat and Mass Transfer / Thermal System Design**

### **Heat Transfer**

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

### **Heat and Mass Transfer**

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.



## Thermal System Design

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

### ๘ 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.

## เครื่องกลเรือ / ต่อเรือ

### ๑ Mechanics of Machinery / Ship Dynamics / Ship Buoyancy and Stability

#### Mechanics of Machinery

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

#### Ship Dynamics

Introduction to ship motion, irregular seaway, motion in irregular seaway, dynamic effects.

#### Ship Buoyancy and Stability

Ship geometry; ship lines, nomenclature of form flotation; buoyancy; computations of areas, volumes and moments, the properties of floating bodies, hydrostatic curves; equilibrium and initial stability; equilibrium of floating objects, initial stability, metacentric radius, the inclining experiment trim, stability curves; cross curves, stability characteristics; weight effects of stability; weight addition, weight removal, grounding and clocking; impaired stability and control of damage, free surface, flooding, permeability, estimates of a damaged ship's condition.

### ๒ Machine Design หรือ Mechanical Design / Ship Design

#### Machine Design หรือ Mechanical Design

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

#### Ship Design

Basic design parameters, estimation of power requirements, weight estimation, initial hull form, preliminary propeller selection and design, ship stability, machinery selection, configuration and arrangement, maneuvering and sea keeping, load line assignment and tonnage measurement, preliminary structural design.

## ୩ Automatic Control / Digital Control / Fluid Power Control

### Automatic Control

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

### Digital Control

Mathematical modeling of engineering systems, principles of feedback control, root locus analysis and design, frequency response design method, discrete time systems and control.

### Fluid Power Control

Basic fluid mechanics. flow, pressure, energy, basic components, pump, valve, motor, fluid power systems, static and dynamic characteristics, feed back control , sensor, controller, actuator, control action, transfer function, sequence control.

## ୪ Mechanical Vibration / Ship Vibration

### 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.

### Ship Vibrations

Basic mechanical vibrations; free vibrations of one-degree of freedom and multi-degree of freedom; simple harmonic, general period, and random forced vibrations; vibrations of ship and off-shore structures; dynamics and vibrations problems of propeller shafts and equipment; vibrations problems of ship panels and curved surfaces.

## ୫ Internal Combustion Engines / Combustion

### 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.

## ୬ Air Conditioning / Refrigeration

### 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.

### **Heat Transfer / Heat and Mass Transfer / Thermal System Design**

#### **Heat Transfer**

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

#### **Heat and Mass Transfer**

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.

#### **Thermal System Design**

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

### **Power Plant Engineering / Ship Propulsion and Engines / Ship Resistant and Powering**

#### **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.

#### **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.

## อากาศยาน / การบินและอวกาศ

### ๑ Mechanics of Machinery /Mechanics of Flight

#### **Mechanics of Machinery**

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

#### **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.

### ๒ Machine Design / Aircraft Design

#### **Machine Design**

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

#### **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.

### ๓ Automatic Control / Digital Control / Automatic Flight Control

#### **Automatic Control**

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

#### **Digital Control**

Mathematical modeling of engineering systems, principles of feedback control, root locus analysis and design, frequency response design method, discrete time systems and control.

#### **Automatic Flight Control**

Automatic control principles, analysis and modelling of linear control elements, stability of feedback control systems, modeling of aircraft dynamics, analysis and design of feedback control systems using both frequency and time domain techniques, application to automatic flight control systems.

### 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.

## ⌘ Internal Combustion Engines / Combustion

### 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.

## ↻ Air Conditioning / Aircraft Air Conditioning and Pressurization Systems

### 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 system, indoor air quality, energy efficiency in a/c system.

### 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.

## ↻ Heat Transfer / Heat and Mass Transfer / Thermal System Design

### Heat Transfer

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

### Heat and Mass Transfer

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.

### Thermal System Design

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

## ↻ Aircraft Power Plant / Aerospace Propulsion

### **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.

### **เมคคาทรอนิกส์**

#### **๑ Mechanics of Machinery / Dynamics of Robotics**

##### **Mechanics of Machinery**

Velocity and acceleration analysis; kinematics and dynamics force analysis of mechanical devices, linkages, gear trains and mechanical systems; balancing of rotating and reciprocating mass.

##### **Dynamics of Robotics**

Acceleration and position analysis, velocity kinematics, force/torque relationships, homogeneous coordinates for kinematics and dynamics, forces and moment balance, dynamic modeling; Euler-Lagrange and Newton-Euler formations, dynamics algorithms, robotics joint, cartesian and force controls, performance analysis of robotics.

#### **๒ Machine Design หรือ Mechanical Design / Mechatronics Design**

##### **Machine Design หรือ Mechanical Design**

Fundamental of mechanical design, properties of materials, theories of failure, design of simple machine elements, rivets, welding, screw fasteners, keys and pins, shafts, springs, gears, power screws, couplings, bearings, brakes, clutches, belts, chains, design project.

##### **Mechatronics Design**

Reviews of strength of materials, design of axial loading member and shaft, mechanism and operation of mechanisms, design of electrical and pneumatic control systems, design of mechanism with on/off control systems, design of beams, bearings, springs, and pulley, design of mechanisms with feedback control systems.

#### **๓ Automatic Control / Digital Control / Fluid Power Control**

##### **Automatic Control**

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

##### **Digital Control**

Mathematical modeling of engineering systems, principles of feedback control, root locus analysis and design, frequency response design method, discrete time systems and control.

### **Fluid Power Control**

Basic fluid mechanics. flow, pressure, energy, basic components, pump, valve, motor, fluid power systems, static and dynamic characteristics, feed back control , sensor, controller, actuator, control action, transfer function, sequence control.

### **↻ 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.

### **↻ Internal Combustion Engines / Combustion**

#### **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.

### **↻ Air Conditioning / Refrigeration / Refrigeration and Air Conditioning**

#### **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 conditioning, cooling load estimation of air conditioning systems, air distribution and duct system design.

### ๗ Heat Transfer / Heat and Mass Transfer / Thermal System Design

#### Heat Transfer

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

#### Heat and Mass Transfer

Modes of heat transfer, laws governing heat conduction, convection, radiation and applications, heat exchangers and heat transfer enhancement, boiling and condensation, laws governing mass transfer and analogy with heat transfer.

#### Thermal System Design

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

### ๘ 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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น



## เนื้อหารายวิชาเฉพาะทางวิศวกรรม

### สาขาวิศวกรรมไฟฟ้า

#### งานไฟฟ้ากำลัง

#### ไฟฟ้ากำลัง

##### **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; the measurement of resistance, inductance, and capacitance; frequency and period/time-interval measurement; noises; transducers.

##### **๒ Electrical Machines**

Magnetic circuits; principles of electromechanical energy conversion; energy and co-energy; single phase and three phase transformer; 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 Electric Power System Analysis**

Transmission and distribution networks calculation; load flow; load flow control; symmetrical short circuit analysis; unsymmetrical short circuit analysis; power system stability; economic operation.

##### **๕ Power Plant and Substation / Electrical Power Generation, Transmission and Distribution**

###### **Power Plant and Substation**

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; lightning protection; grounding systems.

###### **Electrical Power Generation, Transmission and Distribution**

Power system structure; Sources of electric energy; Conventional and renewable energy power plants; Load characteristics; Generator characteristics and models; Power transformer characteristics and models; Transmission line parameters and models;

Electrical power distribution systems; Introduction to distributed generation; Power system equipment

#### ๖ 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.

#### ๗ High Voltage Engineering / Electrical Engineering Materials

##### High Voltage Engineering

Uses of high voltage and over voltage 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; insulation coordination.

##### Electrical Engineering Materials

Structure of materials; Electrical properties of materials; Magnetic properties of materials; Optical properties of materials; Electrical conductors; Introduction to semiconductor devices; Superconductivity; Solid, liquid and gas dielectrics; Applications of materials in electrical power devices

#### ๘ Power Electronics

Characteristics of power electronics devices; power diode; thyristors, power bipolar; MOSFET; IGBT; characteristics of magnetic material; power transformer core; ferrite core; iron powder core; converters; ac to dc converter; dc to dc converter; ac to ac converter; dc to ac converter

#### พลังงาน

#### 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; the measurement of resistance, inductance, and capacitance; frequency and period/time-interval measurement; noises; transducers.

#### ๒ Electrical Machines

Magnetic circuits; principles of electromechanical energy conversion; energy and co-energy; single phase and three phase transformer; 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 Electric Power System Analysis

Transmission and distribution networks calculation; load flow; load flow control; symmetrical short circuit analysis; unsymmetrical short circuit analysis; power system stability; economic operation.

### ๕ Thermal Sciences

Fundamental concepts of thermodynamics, fluid dynamics, combustion and heat transfer; Law of thermodynamics; Ideal gas law; Fluid mechanics; Combustion; Heat transfer; Steady flow devices; Refrigeration cycles; Internal and external flows

### ๖ Distributed Generation Systems

Introduction to distributed generation; Technologies of DG, conventional and renewable technologies; Grid interconnection; Technical impact of distributed generation on distribution systems, loss, voltage profile, reliability, protection, load flow; Smart grids; Economics aspects

### ๗ Renewable Energy

Introduction to energy systems and renewable energy resources; Potential of renewable resources in Thailand; 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

### ๘ 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 management measures and economics analysis

### ระบบควบคุมและการวัดและเมคคาทรอนิกส์

### 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; the measurement of resistance, inductance, and capacitance; frequency and period/time-interval measurement; noises; transducers.

### **୧୩ Electrical Machines**

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

### **୧୪ 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.

### **୧୫ Electric Power System Analysis**

Transmission and distribution networks calculation; load flow; load flow control; symmetrical short circuit analysis; unsymmetrical short circuit analysis; power system stability; economic operation.

### **୧୬ Electrical Power Generation, Transmission and Distribution**

Power system structure; Sources of electric energy; Conventional and renewable energy power plants; Load characteristics; Generator characteristics and models; Power transformer characteristics and models; Transmission line parameters and models; Electrical power distribution systems; Introduction to distributed generation; Power system equipment

### **୧୭ Microprocessors / Computer Systems and Interfacing**

#### **Microprocessors**

Introduction to microprocessors, structure of microprocessors, assembly programming, interface techniques, memories, input-output interfaces, applications of microprocessors in instrumentation systems, applications of microprocessors in automation systems

#### **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.

## **୩) Process Instrumentation / Industrial Sensors and Control Devices**

### **Process Instrumentation**

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.

### **Industrial Sensors and Control Devices**

Principles and applications of industrial sensors including limit switches; photo sensors, proximity sensors, ultrasonic sensors, temperature sensors, pressure sensors, flow sensors, weight sensors, displacement sensors and encoders; principles and applications of industrial control devices including relays, timers, counters, PLC and controllers.

## **୪) Instrumentation System Design / Industrial Automation Systems / Electric Drives**

### **Instrumentation System Design**

Introduction to industrial process control systems; instrumentation symbols and identifications; process drawings; loop and wiring diagram; instrument specification sheet; installing and commissioning instrumentation; plot plans; final control devices; instrument protection.

### **Industrial Automation Systems**

Introduction to industrial control, analog signal conditioning, digital signal conditioning, sensors and transducers, analog controllers, digital controllers, sequence control, programmable logic controllers (PLC), PLC programming, PLC interfaces, PLC applications in automation systems

### **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, types of controllers, DC motor drives, AC motor drives, servo drives systems, applications of drives in industrial automations

## 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; the measurement of resistance, inductance, and capacitance; frequency and period/time-interval measurement; noises; transducers.

### ๒ Principle of Communication

Introduction to signal and systems; spectrum of signal and applications of Fourier Series and transform; analog modulation, AM, DSB, SSB, FM, NBFM, PM; noise in analog communication; binary baseband modulation; Nyquist's sampling theory and quantization; pulse analog modulation, pulse code modulation(PCM), delta modulation (DM); multiplexing, time-division multiplexing (TDM); introduction to transmission lines, radio wave propagation, microwave components and satellite communications, and optical communication.

### ๓ Communication Network and Transmission Lines / Signal and Systems

#### Communication Network and Transmission Lines

Network theorems; analysis and design of equivalent one-port and two-port; series and parallel resonance, multiple resonance, wave filters; impedance transformation and matching networks; network approach to theory of transmission line; utilization of transmission lines for impedance matching.

#### Signal and Systems

Continuous-time and discrete-time signal and systems; linear time-invariant systems (LTI); signal analysis using Fourier transform, Laplace transform, and Z-transform; applications of signal and systems; modern techniques in signal and system analysis.

### ๔ Digital Communication

Review of sampling theorem; probability and random processes; line coding and pulse shaping; signal detections; digital modulation techniques; performance analysis; introduction to information theory; source coding; channel coding.

### ๕ Data Communication and Networking

Introduction to data communications and networks; layered network architecture; point-to-point protocols and links; delay models in data networks; multi-access communication; routing in data networks; data flow control; data security.

### ๖ Optical Communication

Cylindrical dielectric waveguides and propagating conditions; structure and types of optical fiber; optical fiber parameters; optical fiber production; optical cable types; signal degradations in optical fiber; optical sources; modulation techniques; optical detectors; optical receivers; optical repeaters and amplifiers; optical components; link budget calculations.

### ๗ Microwave Engineering

Microwave transmission lines; s-parameters; microwave network analysis; microwave resonators; power dividers and directional couplers; microwave filters; microwave systems and applications; microwave measurement.

### ๘ Antenna Engineering

Basic definitions and theorems; isotropic point source; power and field patterns; directivity and gain; Radiation impedance; wave polarization; radiation from current elements; radiation properties of wire antenna; linear array antenna; Uda-Yagi antenna and log-periodic antenna; aperture antenna; microstrip antenna; antenna measurement.

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## เนือหารายวิชาเฉพาะทางวิศวกรรม

### 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.

## ୧୩ 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.

## ୧୩ 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.

## ୧୪ Quality Control

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

## ୧୫ 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.

## ୧୬ 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

## ୧୭ 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.

## ୧୮ 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.

## โครงการ

### 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 conveyor, continuous-flow conveyor, bucket elevator, screw conveyor, 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 (3D); 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.

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เนื้อหารายวิชาเฉพาะทางวิศวกรรม

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.

## ☞ Air Pollution Control / Design of Air Pollution Control Systems / Noise and Vibration Control

### 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.

### 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.

## ☞ 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.

## ☞ 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.

## **7) 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.

**8) 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**

### **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.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อยวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อยวิชาที่กำหนดไว้ สภาวิศวกร จะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น

เนื้อหารายวิชาเฉพาะทางวิศวกรรม  
สาขาวิศวกรรมเคมี

**๑ 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.

**๒ 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.

**๓ 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.

**๔ Heat Transfer and Mass Transfer**

**Heat Transfer** : Basic principles and mechanisms for heat transfer; conceptual design of heat transfer equipments.

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

**๕ Chemical Engineering Plant Design**

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

**๖ 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.

**๗ Chemical Engineering Thermodynamics**

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

## ๘ 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 processes.

**หมายเหตุ** เนื้อหาของแต่ละรายวิชาที่กำหนดนี้เป็นเพียงเกณฑ์ขั้นต่ำ สถานศึกษาสามารถเพิ่มเติมได้มากกว่าที่ระบุไว้ กรณีที่รายชื่อวิชาที่เปิดการเรียนการสอนไม่ตรงกับรายชื่อวิชาที่กำหนดไว้ สภาวิศวกรจะพิจารณาโดยการเทียบเนื้อหาของรายวิชานั้น ๆ กับเนื้อหาของรายวิชาที่กำหนดไว้ข้างต้น