Struktur Kurikulum Program KKI Teknik SIPIL

Code	Subject	CP	Code	Subject	CP
	1st Semester			**2nd Semester**	
UIGE610002	Academic Writing	3	ENGE 6 1 0002	Calculus 2	3
ENGE 6 1 0001	Calculus 1	3	ENGE 6 1 0004	Linear Algebra	4
ENGE 6 1 0005	Physics (Mechanics and Thermal)	3	ENGE 6 1 0007	Physics (Electricity, MWO)	3
ENGE 6 1 0006	Physics(Mechanics and Thermal) Laboratory	1	ENGE 6 1 0008	Physics (Electricity, MWO) Laboratory	1
ENGE 6 1 0009	Basic Chemistry	2	ENCV612001	Advanced Chemistry	2
ENGE 6 1 0010	Statistic and Probability	2	ENCV612002	Construction Drawing	2
ENCV611001	Introduction to Civil Engineering System	3	ENCV612003	Statics	4
ENCV611002	Material Properties	3			
	Sub Total	**20**		**Sub Total**	**19**
	3rd Semester			**4th Semester**	
ENGE 6 1 0011	Engineering Economics	3	ENGE 6 1 0012	Health, Safety and Environmental Protection	2
ENCV613001	Advanced Calculus	3	ENCV614001	Numerical Method	2
ENCV613002	Building Construction	3	ENCV614002	Surveying	3
ENCV613003	Solid Mechanics	4	ENCV614003	Structural Analysis	3
ENCV613004	Basic Soil Mechanics	3	ENCV614004	Soil Mechanics	3
ENCV613005	Fluid Mechanics	3	ENCV614005	Transportation Engineering	3
			ENCV614006	Hydraulics	3
	Sub Total	**19**		**Sub Total**	**19**
	5th Semester			**6th Semester**	
UIGE610004	Integrated Character Building Course B	6	UIGE610001	Integrated Character Building Course A	6
ENCV615001	Steel Structure 1	3	UIGE610003	Sport/ Art	1
ENCV615002	Foundation Engineering	3	ENCV616001	Concrete Structure 1	3
ENCV615003	Road Geometric Design	3	ENCV616002	Pavement Design	3
ENCV615004	Water Engineering 1	3	ENCV616003	Water Engineering 2	3
ENCV615005	Ethics and Legal Aspect of Construction Contract	2	ENCV616004	Construction Management	2
			ENCV616005	Construction Methods & Equipments	2
	Sub Total	**20**		**Sub Total**	**20**
	7th Semester			**8th Semester**	
ENCV617001	Capstone Project	3	UIGE610005	Islamic Studies	2
ENCV610001	Internship	3	UIGE610006	Catholic Studies	
ENCV610002	Seminar	1	UIGE610007	Christian Studies	
			UIGE610008	Hindu Studies	
			UIGE610009	Buddhist Studies	
			ENCV 618 001	Enterpreneurship	2
			ENCV610003	Final Project	4

	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	6		Students choose 12 credits of elective courses offered by : (1) undergraduate/ postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	6
	Sub Total	**13**		**Sub Total**	**14**
				TOTAL	**144**

Elective Courses on Civil Engineering Undergraduate Program

Code	Subject	CP	Code	Subject	CP
	7th Semester			**8th Semester**	
ENCV 617 002	Civil Engineering System	3	ENCV 618 002	Steel Structure 2	3
ENCV 617 003	Sustainable Built Environment	3	ENCV 618 003	Construction Methods in Geotechnic	3
ENCV 617 004	Concrete Structure 2	3	ENCV 618 004	Stormwater Management	3
ENCV 617 005	River Engineering	3	ENCV 618 004	Urban Planning and Sanitation	3
ENCV 617 006	Environmental Impact Analyses and ISO	3			

Elective Courses on Civil Engineering Master Program

Code	Subject	CP	Code	Subject	CP
	7th Semester			**8th Semester**	
	Structure			**Structure**	
ENCV801101	Prestressed Concrete Structure	3	ENCV802101	Earthquake Resistance Building	3
ENCV801102	Structural Dynamics	3	ENCV802102	Finite Element Method	3
ENCV803101	Offshore Structure	P	ENCV802103	Advanced Mechanics of Material	3
ENCV803102	Bridge Structure	P	ENCV802104	Advanced Steel Structure	3
ENCV803103	Highrise Structural Building	P	ENCV802105	Concrete Technology & Adv. Reinforced Concrete	3
	Geotechnics			**Geotechnics**	
ENCV 801 201	Advanced Soil Mechanics	3	ENCV802201	Slope Stabilization and Soil Improvement	3
ENCV 801 202	Geotechnic Investigation	3	ENCV802202	Environmental Geotechnics	3
ENCV 803 201	Adv. Foundation Engineering & Deep Excavation	3	ENCV802203	Numerical Methods in Geotechnical Engineering	3
ENCV 803 202	Diynamics & Earthquake in Geotechnic	3			
ENCV 803 203	Special Topics in Geotechnics	3			
	Water Resources Management			Water Resources Management	

ENCV 801 401	Engineering Hydrology	3	ENCV802401	Environmental Fluid Mechanics	3
ENCV 801 402	Ground Water Hydraulics	3	ENCV802402	Water Resources Management	3
			ENCV802403	Hydraulics Structures	3
	Transportation			**Transportation**	
ENCV 801 301	Traffic Control Engineering	3	ENCV 802 301	Transportation Economics	3
ENCV 801 302	Transportation System	3	ENCV 802 302	Transportation Policy	3
ENCV 803 302	Public Tranport Management and Planning	3	ENCV 802 303	Transportation Safety	3
ENCV 803 303	Harbor Transportation Management and Planning	3			
ENCV 803 304	Airport Planning and Management	3			
ENCV 803 305	Advanced Road Geometric Design				
	Construction Management			**Construction Management**	
ENCV 801 601	Project Investment and Finance	3	ENCV802601	Time & Cost Management	3
ENCV 803 601	Human Resource and Project Communication Management	3	ENCV802602	Quality & Risk Management	3
ENCV 803 605	Management System of Health, Safety and Environment	3	ENCV802603	Procurement Management, Contract & Claim Administration	3
			ENCV802604	Advanced Construction Methods & Equipments	3

COURSE SYLLABUS

ENCV611001
Introduction to Civil Engineering System
3 Credits
Learning Outcomes :

1. Students will be able to elaborate the working scope of Civil Engineering with its sub-expertise for a system related to Civil Engineering work;
2. Be able to work in a team;
3. Be able to deliver the ideas in oral or written form.

Competencies in Curriculum: WA 6 (engineer's role in society), WA7 (environment and sustainability), WA 9 (Team work), WA 10 (communication skill)
Syllabus : Introducing the system and working scope of Civil Engineering: General description of the system and work scope of Civil Engineering, General Description about the sub-expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management; Components and Functions of buildings/infrastructures in Civil Engineering: Physical and non-physical components of buildings/infrastructures in Civil Engineering, Functions of physical and non-physical of buildings/ infrastructures in Civil Engineering; Role of Civil Engineering Bachelors: Roles of Civil Engineering Bachelors in areas of expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management, Relationship between scope of work between areas of expertise.
Prerequisites : -
Text Book References : -

ENCV611002
Material Properties
3 Credits

Learning Outcomes :

1. Students will be able to explain comprehensively the definition of practical and elementary aspects of materials in the Civil Engineering field related to the tension-strain relationship, elasticity, behavior through time, damping property, atom structures, plasticity, yielding criteria, fatigue, ductility, and corrosion process;
2. Be able to design concrete mix design materials according to the desired concrete compressive strength; able to explain the compression test process of a cylinder concrete sample and the tensile test of steel reinforcement in the laboratory and able to explain the meaning of the test results;
3. Be able to work in a team.

Competencies in Curriculum : *prior knowledge* for WA 1 (Engineering knowledge), WA 4 (experiment), WA9 (team work)

Syllabus : Particulate Material, aggregate, Portland Cement and Portland Cement Concrete, Structural Steel, Asphalt Cement and asphalt concrete, wood, plastic and polymer, Concrete Fibers, basis of materials and solids, microstructure and surface properties, material responses to stresses, yielding and facture, rheology of fluid and solid; fatigue

Prerequisites: -

Text Book References :

1. S. Young, Sidney, The Science and Technology of Civil Engineering Materials, Prentice-Hall International Inc., 1998
2. Shan Somayaji, 2001, Civil Engineering Materials, Prentice Hall.
3. Robert D Kerbs, Richad D Walker, (1971) Highway Materials, McGraw-Hill

ENCV612001

Advanced Chemistry

2 Credits

Learning Outcomes : Students will be able to apply and report their knowledge about basic chemistry and environment to investigate the two-way interaction between materials and civil engineering structure's life cycle with its environment (C3. A2).

Competencies in Curriculum : In order to achieve competencies of WA1 (Engineering knowledge) and WA7 (environment and sustainability)

Syllabus : Spontaneity reaction (Irregularities concept, enthalpy, entropy, Gibbs free energy, Arrhenius Equation), spontaneous and non- spontaneous reaction (Temperature effect, concentration and energy effect to spontaneity, cement production process), Steel production process (Mining and Purification of minerals, iron extraction from mineral, steel production), Chemical weathering of building's material (Causes and mechanisms of acid rain formation, ettringite formation and characteristic, ettringite impact to building's strength, metal reaction to acid, acid rain's effect to metal, aggressive and corrosive environment, examples of material protection methods), civil engineering building's life cycle concept (life cycle concept, production process, transportation, construction, operation, and end of life of the building), cement and steel production effect to air pollution escalation (by-product of cement production process, by-product of steel production process, cement and steel industry contribution to CO2 and particulate level in the air), Pollution caused by civil building's life cycle (Pollution of air, water and soil from construction and operation process of civil engineering building's)

Prerequisites : Basic Chemistry

Text Book References :

1. Brown and Holme, 2011, Chemistry for Engineering Students 2nd edition
2. Rainer Remus, Miguel A. Aguado-Monsonet, Serge Roudier and Luis Delgado Sanch, 2013, Best Available Techniques (BAT) Reference Document for Iron and Steel Production, EU Commission
3. Colin Baird, Michael Cann, 2008, Environmental Chemistry 4th edition, W. H. Freeman
4. A. Moncmanová, 2007, Environmental Deterioration of Materials, WIT Press
5. Frauke Schorcht, Ioanna Kourti, Bianca Maria Scalet, Serge Roudier, Luis Delgano Sancho, 2013, Best Available Techniques (BAT) Reference Document for Cement, Lime and Magnesium Oxide, EU Commission
6. Building and Environment, Elsevier
7. Georgia Institute of Technology, 2010, AIA Guide to Building Life Cycle Assessment in Practice, The American Institute of Architects
8. Georgia Institute of Technology, 2010, AIA Guide to Building Life Cycle Assessment in Practice, The American Institute of Architects

ENCV612002

Construction Drawing

2 Credits

Learning Outcomes :

1. Students will be able to explain engineering drawing symbols in Civil Engineering field and draw it manually

or using a software (AutoCAD);
2. Be able to design a one-floor simple healthy house building;
3. Be able to draw the one-floor simple healthy house building according to rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing.

Competencies in Curriculum: *Prior knowledge* for WA5 (*modern tool usage*) and achieving competency WA10 (communication skill)

Syllabus : introduction to Civil Engineering knowledge discipline scope and Civil Engineering building construction, introduction to engineering drawing, benefit and purpose of drawing in design process; introduction to drawing tools, drawing paper format, drawing head, standards, lettering, leader, and scale; geometric construction; pictorial projection; orthogonal projection; section view drawing; details of the building drawing, construction drawing of wooden and light steel rooftop; beam construction drawing, column and river stone foundation; electrical installation drawing and plumbing drawing

Prerequisites:

Text Book References:

1. Neufret, Ernst, *Data Arsitek Jilid 1 dan 2*, Penerbit Erlangga, Jakarta, 1989
2. Subarkah, Imam, *Konstruksi Bangunan Gedung*, Penerbit Idea Dharma, Bandung, 1988
3. Sugiharjo, R., *Gambar-Gambar Dasar Ilmu Bangunan*, Penerbit R. Sugihardjo
4. Giesecke, F. E., et al. (1997). Technical Drawing, Tenth Edition, Prentice Hall Publishing,

ENCV612003

Statics

4 Credits

Learning Outcomes :

1. Students will be able to apply the mechanics physics concept in calculating responds from rigid body as results of working forces (C3);
2. Be able to apply the mechanics physics concept in analyzing simple structure of beam, trusses, and three joints arch (C3).

Competencies in Curriculum : WA 1 (Engineering knowledge)

Syllabus : Statics of particle; rigid body; equilibrium of rigid body; structural analysis of trusses with point equilibrium method; influential lines for statically determinate structure caused by moving loads

Prerequisites : Heat and Mechanics Physics

Text Book References :

1. Aslam Kassimali, Structural Analysis, 4th edition, 2011
2. R.C. Hibbeler, Structural Analysis, Prentice Hall, 1998
3. Lecture Notes "*Mekanika Teknik*", Elly Tjahjono
4. Lecture Notes "*Garis Pengaruh*", Elly Tjahjono

ENCV613001

Advanced Calculus

3 Credits

Learning Outcomes : Students will be able to derive and use the concept of: ordinary differential equation and calculus vector in order to solve its applied problems. (C2)

Competencies in Curriculum: *Prior knowledge* for WA1 (basic math)

Syllabus : Introduction to Differential Equations, Definitions and Terminology, Initial-Value Problems, Differential Equations as Mathematical Models, First-Order Differential Equations, Solution Curves without a Solution, Direction Fields, Autonomous First-Order Differential Equations, Separable Equations, Linear Equations, Exact Equations, Solution by Substitutions, A Numerical Method, Linear Models, Nonlinear Models, Modeling with Systems of First-Order Differential Equations.

Higher-Order Differential Equations, Theory of Linear Equations, Initial-Value and Boundary-Value Problems, Homogeneous Equations, Nonhomogeneous Equations, Reduction of Order, Homogeneous Linear Equations with Constant Coefficients, Undetermined Coefficients, Variation of Parameters, Cauchy-Euler Equations, Nonlinear Equations, Linear Models; Initial-Value Problems, Spring/Mass Systems: Free Undamped Motion, Spring/Mass Systems: Free Damped Motion, Spring/Mass Systems: Driven Motion, Series Circuit Analogue, Linear Models : Boundary-Value Problems, Green□s Function (Initial-Value and Boundary-Value Problems), Nonlinear Models, Solving Systems of Linear Equations. Vector Functions, Motion on a Curve, Curvature and Components of Acceleration, Partial Derivatives, Directional Derivative, Tangent Planes and Normal Lines, Curl and Divergence, Line Integrals, Independence of the

Path, Double Integrals, Double Integrals in Polar Coordinates, Green□s Theorem, Surface Integrals, Stokes□ Theorem, Triple Integrals, Divergence Theorem, Change of Variables in Multiple Integrals.
Prerequisites : Calculus 1 and Calculus 2
Text Book References :
1. D.G Zill and W.S Wright, Advanced Engineering Mathematics, 5th ed., Jones & Barlett Learning, 2014
2. E. Kreyzig, Advanced Mathematical Engineering, John Wiley & Son, 5th ed., 2011

ENCV613002
Building Construction
3 Credits
Learning Outcomes:
1. Students will be able to apply the knowledge of engineering drawing symbols in Civil Engineering field for describing a two-story building according to the rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing;
2. Be able to read the construction drawing and explain the parts of water structure (dam), waste treatment building, geotechnical building (foundation, retaining wall), roads, and bridges according to the construction drawing;
3. Be able to calculate the volume of the building, unit price, and cost estimation.

Competencies in Curriculum: WA1 (engineering knowledge); WA 10 (communication skill), and *Prior knowledge* for WA 5 (modern tool usage)
Syllabus : Introduction of the course syllabus, introduction of standards of every building element and room function, plan and appearance drawing of a building, section-view drawing, foundation plan drawing, column and beam construction drawing, rooftop and trestlework plan drawing, platform drawing, stairs drawing, plafond and floor pattern drawing, window and door frames drawing, lighting installation drawing; plumbing system drawing, fire prevention installation drawing; lightning rod installation drawing, solid waste/trash drawing and septic tank drawing. Calculation of the building's volume and cost estimation. Unit Price. Journals.
Prerequisites : Construction Drawing
Text Book References:
1. Neufret, Ernst, *Data Arsitek Jilid 1 dan 2*, Penerbit Erlangga, Jakarta, 1989
2. Subarkah, Imam, *Konstruksi Bangunan Gedung*, Penerbit Idea Dharma, Bandung, 1988
3. Sugiharjo, R., *Gambar-Gambar Dasar Ilmu Bangunan*, Penerbit R. Sugihardjo
4. Tanggoro, Dwi, *Utilitas Bangunan*, Penerbit Universitas Indonesia, 2000

ENCV613003
Solid Mechanics (3+1)
4 Credits
Learning Outcomes :
1. Students will be able to analyze tension and shape changes as a result of working forces for various shape of statically determined structure and various shape of sections and type of materials;
2. Be able to calculate the deflection of beam, portal, and trusses structure using the beam, moment area, and energy theory and use the knowledge to analyze a simple statically undetermined structure using the principals of consistent deformation.

Competencies in Curriculum : WA1 (engineering knowledge)
Syllabus : The meaning of loads and forces working on a solid object, effect of forces to a solid object, stresses on a solid object, shape deformation of a solid object, characteristics of shape deformation of a solid object, elastic and inelastic phases, axial strain, Modulus of Elasticity, Poisson Ratio. Section Properties, area, center of gravity, cross-axis system, maximum moment of inertia of a section, minimum moment of inertia of a section, radius of gyration, symmetric section, asymmetric section. Normal stress due to axial internal forces, normal stress due to flexure, combination of normal stress and flexure, one way and two-way flexural stress, core area (Kern), shear stress due to transversal internal forces, shear stress due to torsion internal forces. Combination of normal and shear stresses. Stresses on inclined plane and primary stresses.
Deflection of beam, portal, and trusses of statically determined structure caused by external forces using elastic deformation line differential equation method, moment area of an equivalent beam method, energy/unit load method. Simple analysis of statically undetermined structure with the principals of consistent deformation
Prerequisites : Statics

Text Book References :

1. Hibbeler, R.C., Mechanics of Materials, 8/e, Pearson, 2011
2. Beer, F. and Johnston, P., Mechanics of Materials, 6/e. McGraw Hill, 2011
3. Egor P. Popov (Author), Engineering Mechanics of Solids (2nd Edition), Prentice Hall, 1998
4. Gere, J.M. and Timoshenko, S.P. (1997). Mechanics of Materials, 4th ed., PWS Publishing Co., Boston, Mass.
5. Vable, M., Mechanics of Materials, http://www.me.mtu.edu/~mavable/MoM2nd.htm
6. James M. Gere, *Mekanika Bahan* 1 ed.4, Penerbit Erlangga, Kode Buku: 37-01-010-6 Tahun: 2000
7. James M. Gere, *Mekanika Bahan* 2 ed.4, Penerbit Erlangga, Kode Buku: 37-01-010-7 Tahun: 2002

ENCV613004

Basic Soil Mechanics (2+1)

3 Credits

Learning Outcomes : Students will be able to explain the basic understanding of geology and able to explain the physical properties of soil and its parameters which covers its application in civil engineering.

Competencies in Curriculum : WA1 (engineering knowledge) and WA2 (problem analysis) also *Prior knowledge* for WA 4 (experiment) and WA 9 (team work)

Syllabus : Geological Engineering and Soil Properties; Definitions of geological knowledge, geotechnics with other disciplines/civil; topography and geomorphology map; definition and meaning of units in topography and its tools; how to read and analyze mineralogy, stone types, and stratigraphy, introduction to type of minerals forming igneous rock, geological structure and its types; how to identify and understand the effect of coating, stocky, fault, and unconformity for construction; weathering and movement of soil; introduction of types, processes, and identification of weathering; Explanation of classification process; Geological and Geotechnical maps; analyzing basic topography maps; Criteria of geotechnics geological maps; soil properties: soil in three phases; physical characteristics of soil; soil classification, Atterberg Limit; soil compaction theory and CBR test; one flow dimension in soil, permeability and introduction to groundwater seepage, flow diagram stress theory and the effective stress principal; effective stress reaction because of the change of total stress in a fully saturated soil; soil shear strength theory; laboratory soil shear strength test for clay and sand; consolidation theory and test;

Prerequisites : Material Properties

Text Book References :

1. Burchfiel BC & Foster RJ et .al., "Physical Geology", Charles E Merril Publishing Co., Colombus Toronto London Sydney, 1986.
2. Blyth, F.G.H. & de Freitas, M.H., "A Geology for Engineers, 7th Ed.". Elsevier. 2005.
3. Craig, R.F., " Soil Mechanics, 7th Ed.", 2007
4. Bowles, J.E., "Physical and Geotechnical Properties of Soils", McGraw-Hill Kogagusha Ltd., 1998.
5. Das, B.M., "Principles of Geotechnical Engineering", Fifth edition, 2005, PWS Publishing Company, Boston
6. Budu M., "Soil Mechanics and Foundations", Second Edition, 2007, John Wiley& Sons, New York

ENCV613005

Fluid Mechanics

3 Credits

Learning Outcomes :

1. Students will be able to analyze fluid pressure distribution at a given static situation to be applied for load calculation of structure stability of civil building;

2. Be able to analyzed fluid in motion to be applied for calculation of total flow and the induced dynamic forces;

Competencies in Curriculum : WA 1 (Engineering knowledge).

Syllabus : The most important basic science in civil engineering is mechanics knowledge. This knowledge can be separated into material mechanics and fluid mechanics. The mechanics of fluid discuss about the basic formulation of motion and forces of an object that cannot be perceived as completely integrated fluid, such as wind and water. This knowledge is the basis for all of the water resources engineering subjects, such as Hydraulics, Hydrology, Design of Water Infrastructure, Ground Water Resources, Water Surface Management and Development, etc. Until midterms, the materials that will be discussed is static fluid which covers the definition of pressure, pressure distribution formulation, and the application of the formula to determine the force as an effect from the pressure for various civil engineering buildings. The other half of the semester, the materials that will be discussed is flowing fluid, starting from the Eulerian movement conceptualization and its application in the law of mass, momentum, and energy conservation to calculate the total flow and dynamic force induced by the law. The total flow and force obtained will be the basis of particularly hydraulic building design or civil engineering buildings in general.

Prerequisites : Calculus I, Calculus II, Basic Physics I, Basic Physics II, Basic Physics Laboratory I, Basic Physics

Laboratory II

Text Book References :

1. Merle C. Potter, David C. Wiggert, Bassem H. Ramadan, Mechanics of Fluids, Fourth Edition, Cengage Learning, 2011
2. Frank M. White, Fluid Mechanics, Fourth Edition, McGraw-Hill, 1998

ENCV614001

Numerical Method

2 Credits

Learning Objective : Students will be able to solve mathematics equation on linear algebra and differential equation with numerical method using MatLab software.

Competencies in Curriculum : *Prior knowledge* for WA 1 (Engineering knowledge) and WA5 (modern tool usage)

Syllabus : Introduction to MATLAB (programming basics with MATLAB), Searching for root equation (Bracketing Method & Open Method); Linear System (Solving Simultaneous Linear Algebraic Equation, Gauss Elimination, LU-Factorization, Matrix Inversion, Solution by Iteration, Eigenvalues). Numerical Method in Curve Fitting (Linear Regression & Least Square), Numerical Method in solving: Ordinary Differential Equations (Initial Value Problems, Adaptive Method and Stiff System, Boundary Value Problems)

Prerequisites : Calculus 1, Calculus 2, Advanced Calculus, Linear Algebra

Text Book References:

1. Numerical Methods for Engineers, Steven C. Chapra & Raymond P Canale, 7th edition, 2013
2. Applied Numerical Methods with MATLAB for Engineers and Scientist, 3rd edition, Steven C. Chapra, McGraw Hill, 2012

ENCV614002

Surveying (2+1)

3 Credits

Learning Outcomes :

1. Students will be able to use various measuring instruments to solve mapping problems and pegs in civil engineering and environmental engineering works, surveying and displaying the results in a form of drawing with integrating various measuring methods and able to read and draw the data from the surveying results done by someone else;
2. Be able to work in team.

Competencies in Curriculum : *prior knowledge* for WA 4 (experiment) and WA9 (team work)

Syllabus : Explanation of surveying concept in civil engineering and environmental engineering works; introduction to distance measuring equipment, angles and other measuring equipment usually used in mapping and pegging; Operating levelling equipment and Theodolite in order to take field's data and integrating the data into a map or transferring design coordinates into the field coordinates in civil engineering and environmental engineering activities; carrying out field measuring with measuring methods of horizontal, vertical distance, and angle measurement; Error theory; planning of basic concept of mapping and pegging; calculation of area and volume; displaying the field measuring results in a corresponding map for the needs of civil engineering and environmental engineering

Prerequisites : Calculus 1, Calculus 2, and Construction Drawing

Text Book References :

1. Kavanagh, B. and Slattery, D., 2014. Surveying with Construction Applications 8th ed., Prentice-Hall, Inc.
2. Irvine, W., 2005. Surveying for Construction 8th ed., McGraw-Hill Higher Education.
3. Uren, J. and Prince, W., 2010. Surveying for Engineers 5th ed., Palgrave MacMillan.
4. Schofield, W. and Breach, M., 2007. Engineering Surveying 6th ed., CRC Press.

ENCV614003

Structural Analysis

3 Credits

Learning Outcomes :

1. Students will be able to analyze statically undetermined structural responses of truss, beams, frames and arches affected by external loads and degradation of placement using methods such as slope deflection method and moment distribution (cross-method);
2. Be able to analyze 2D spatial structure using direct stiffness method with computer aid (matrix method);

3. Be able to apply moment distribution principal in analyzing influence line in continuous beam structure.

Competencies in curriculum : WA2 (problem analysis)

Syllabus : Definition of statically undetermined vs. determined structure, external statically undetermined structure, *Slope deflection* and moment distribution for continuous beam with various condition of placement, fixed portal and portal that have single/double swinging factors, *gable frame*, symmetrical and asymmetrical structure; Influential lines of placement reactions, influential lines of transversal force and flexural moment for continuous beam. Virtual working principals and energies used in structural analysis;
Superposition matrix method in structural analysis; Implementation of superposition matrix method for 2D spatial Structure

Prerequisites : Statics, Material Property and Solid Mechanics

Text Books References :

1. Hibbeler,R.C., Structural Analysis, Prentice Hall, 1998
2. Aslam Kassimali, Structural Analysis, 4th edition, 2011
3. Ghali A., A.M. Neville, Structural Analysis : A unified Classical and Matrix Approach, 4th ed., Thompson pub., 1997
4. Marc Hoit, Computer-Assisted Structural Analysis and Modelling, Prentice Hall, Englewood Cliffs, New Jersey, 1995
5. Katili, Irwan, *Metode Elemen Hingga untuk Skeletal*, Rajawali Pers, 2008

ENCV614004

Soil Mechanics (2+1)

3 Credits

Learning Outcomes :

1. Students will be able to apply basic soil parameter knowledge on calculating soil strength and stability for simple buildings/civil engineering construction;
2. Be able to design soil retaining wall and draw it according to the rules and regulations of engineering drawing;
3. Be able to use SLOPE/W software to analyze slope stability.

Competencies in curriculum : WA 2 (problem analysis), WA3 (design), WA5 (modern tool usage) and prior knowledge for WA 4 (experiment) and WA 9 (team work)

Syllabus : Bearing capacity of the soil: Allowable bearing capacity and Ultimate bearing capacity due to inclination and eccentricity of load; One dimensional elastic settlement and consolidation settlement; Drawing shallow foundation design; Seepage through dam; Stress distribution in the soil: A point load, strip, circle, and square area of footing using Fadum and Newmark theories; Lateral earth pressure: Rankine and Coulomb theories; Structure design of earth retaining wall, gravity wall, cantilever wall, earth retaining cantilever wall, sheet pile; Slope stability: concept of slope stability, undrained analysis, slice method, introduction of Fellenius method, Bishop method, Soil stability method

Prerequisites : Basic Soil Mechanics

Text Books References:

1. Craig, R.F., "Soil Mechanics, 7th Ed.", 2007
2. Bowles, J.E., "Physical and Geotechnical Properties of Soils", McGraw-Hill Kogagusha Ltd., 1998.
3. Das, B.M., "Principles of Geotechnical Engineering", Fifth edition, 2005, PWS Publishing Company, Boston
4. Budhu M., "Soil Mechanics and Foundations", Second Edition, 2007, John Wiley& Sons, New York

ENCV614005

Transportation Engineering

3 Credits

Learning Outcomes : Students will be able to design road segment and intersection using traffic variables, decipher the characteristics of modes of transportations and designing steps of urban transportation.

Competencies in Curriculum : WA1 (engineering knowledge), WA2 (problem analysis) and WA 5 (modern tool usage)

Syllabus : Types, characteristics, and facilities for a single mode and multi-modes of transportations (e.g. transportation modes, parking, and terminal); variables related to the characteristic of traffic and parking flows; measuring and analyzing variables of traffic characteristics; calculating the segment capacity and simple intersection with the rules of *Manual Kapasitas Jalan Indonesia* (MKJI) and Highway Capacity Manual (HCM); Measuring the variables mentioned in the filed with a traffic control equipment for intersection; Introduction to *Four step model (link, nodes, zone).*

Prerequisites: Calculus 1, and Statistic and Probabilistic

Text Book References :

1. Papacostas, C. and Prevedouros, P., 2000. Transportation Engineering and Planning 3rd ed., Prentice-Hall, Inc.

2. Banks, J., 2002. Introduction to Transportation Engineering 2nd ed., McGraw-Hill.

3. Fricker, J. and Whitford, R., 2004. Fundamentals of Transportation Engineering: A Multimodal System Approach. In Prentice Hall.

ENCV614006
Hydraulics
3 Credits
Learning Outcomes: Students will be able to apply the mass and momentum conservation law to be applied as the fundamental design of water flow under pressure, and water flow in open drainage system.
Competencies in Curriculum : WA1 (engineering knowledge) and WA2 (problem analysis)
Syllabus : Hydraulic is an application of the law of mass, energy, and momentum conservation which is applied theoretically in drainage medias generally found in civil engineering world. These drainage media cover flows in pipes (under pressure), and flows in open drainage system (the water surface has atmospheric pressure). Until midterms, awareness is built to obtain the formulation that can be used in designing dimension which basically needed in formulating energy lost. This concept is introduced in designing a piping system. After the midterm, the energy lost concept is continued by applying it to an open drainage system. Due to the incapability of obtaining accuracy just by using the theoretical formulation for energy loss, it is introduced that the application for some of the water structures will be forced to use empirical coefficient.
Prerequisites : Fluid Mechanics
Text Book References :
1. Merle C. Potter, David C. Wiggert, Bassem H. Ramadan, Mechanics of Fluids, Fourth Edition, Cengage Learning, 2011.
2. Frank M. White, Fluid Mechanics, Fourth Edition, McGraw-Hill, 1998.

ENCV615001
Steel Structure 1
3 Credits
Learning Outcomes :
1. Students will be able to analyze the strength of a simple steel structure;
2. Be able to proportionate the simple steel structure building such as steel trestlework or pedestrians bridge with steel trusses structures according to the regulations and standards applied and present the designed structure with a design engineering drawing;
3. Be able to work together in a team.

Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA9, (team work) and WA10 (communication skill)
Syllabus : Basic steel structural system; Types of steel structure; Mechanical properties; factors which influences the steel's quality, Stress strain steel curve, Steel material property; Proportion of structural member with LRFD against tensile strength, compressive force, bending strength, and shear force according to the standards; Steel structure element analysis and design: tension rod, compression rod, elastic buckling, inelastic buckling, two-way flexure, shear, lateral-torsion buckling; Design and analysis of steel structural joints; Bolt joints; HTB; Welded joints; Pedestrian bridge/trestle roof design
Prerequisites : Statics, Solid Mechanics, Material Properties
Text Books References :
1. Spesifikasi untuk Bangunan Gedung Baja Struktural; SNI 1729: 2015
2. Segui, William T., Steel Design,5th edition, 2013
3. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 1
4. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 2
5. Structural Steel Design, Prentice Hall, 2012

ENCV615002
Foundation Engineering
3 Credits
Learning Outcomes :
1. Students will be able to explain the soil parameters needed for analysis and design process of deep foundation and deep retaining wall system;
2. Be able to explain the basic of deep foundation from analytical, design and construction aspect;

3. Be able to explain the basic of deep foundation load test;
4. Be able to explain the basic of deep retaining wall system from analytical, design and construction aspect.

Competencies in curriculum : WA2 (problem analysis), WA3 (design), and WA10 (communication skill)

Syllabus : Introduction to types and system of deep foundation, methods to determine the axial bearing capacity of deep foundation; Methods to determine the lateral bearing capacity of deep foundation; Methods to determine vertical and lateral deformation of deep foundation; Pile test method and introduction to types and systems of deep soil retaining structures; Soil retaining system calculation methods, as well as understanding the soil parameters needed; Drawing a deep foundation design

Prerequisites : Soil Mechanics

Text Books References:

1. Bowles, J.E., "Foundation Analysis and Design", International Student Edition, McGraw-Hill, Kogakusha, Ltd., Japan, 1988
2. Coduto D.P., "Foundation Design", Prentice Hall, Inc.,1994
3. Poulos, H.G & Davis, E.H., "Pile Foundation Analysis and Design", John Wiley & Sons, Inc., 1980.
4. Prakash S & Sharma HD., Pile foundation in Engineering Practice, John Wiley $ Sons, 1990
5. Tomlinson M. and Woodward J., "Pile Design and Construction Practice, 5th Ed.", Taylor & Francis, Oxon, UK., 2007
6. Reese L.C., Isenhower W.M. and Wang S.-T., "Analysis and Design of Shallow and Deep Foundations", John Wiley & Sons, Inc., Hoboken, USA., 2006.
7. Fleming K., Weltman A., Randolph M., and Elson K.," Piling Engineering, 3rd Ed.", Taylor & Francis, Oxon, UK., 2009

Journal References:

1) ASCE, journals in geotechnics and geomechanics
2) Canadian Geotechnical Journal

ENCV615003

Road Geometric Design

3 Credits

Learning Outcomes :

1. Students will be able to design simple highway geometric by considering economic, environmental issues, comfort and safety principles;
2. Be able to present the results of the design in a shop drawing according to the rules and regulations of engineering drawing.

Competencies in curriculum : WA 1 (engineering knowledge), WA2 (problem analysis), WA3 (design), WA10 (communication skill)

Syllabus : Introduction to Indonesia's norms, standards, codes and manuals for geometric design; Highway classification and functions; Design criteria and control: vehicles, drives, capacity, safety, environmental and economic factors; Design elements: sight distance, horizontal and vertical alignment; Cut and fill analysis; Elements of road cross section: right of way, lanes, curb, median, pedestrian and bicycle facilities; Drainage design for road; Stacking; Road lighting; Project work: A complete set of road geometric design and other complementary road structures.

Prerequisites : -

Text Books References :

1. J.G. Schoon (1993): Geometric Design Project for Highway, ASCE
2. Direktorat Jendral Bina Marga (1997): *Standar Perencanaan Geometrik Jalan Luar Kota*
3. Direktorat Jendral Bina Marga (1990): *Petunjuk Desain Drainase Permukaan Jalan*
4. Sudarsono DU, *Konstruksi Jalan Raya*, Penerbit PU
5. Guide for Design of Pavement Structures, AASHTO, 1986
6. *Standar Perencanaan Tebal Perkerasan Lentur*, Bina Marga, Penerbit Departemen PU, 1983
7. AASHTO Maintenance Manual, AASHTO 1987
8. Krebs RD, Walker Richard D, Highway Material, McGraw-Hill, 1974

ENCV615004

Water Engineering 1

3 Credits

Learning Outcomes :

1. Students will be able to set the dimension of a channel, culverts, spillway and storage of reservoir/retention pond, in a catchment area with an area not exceeding 50 Km2, based on topographical map with 1:25.000 scale, rain data at the rain station in and/or around the catchment area, domestic water needs survey result and social-economy data in the related district. (C4);

2. Be able to self-organize when working independently or in a group, hence the students can demonstrate the ability to master the course in the form of systematic written documents and an effective and efficient oral presentation (A4).

Competencies in curriculum : WA 1 (engineering knowledge), WA2 (problem analysis), WA3 (design), WA9, (team work) and WA10 (communication skill)

Syllabus : Determining the dimension of a channel, culverts, and reservoir/retention pond spillway based on the calculation of planned flood debit and open channel hydraulics, and determining the dimension of reservoir/retention pond based on water balance calculation. The learning method consists of introductory lecture, individual/group exercises in and out of the class, as well as presentation and writing paper as a group final project. The final project consists of a task to design channel, culvert, spillway and storage of reservoir/retention pond, in a catchment area with an area not exceeding 50 Km2, based on topographical map with 1:25.000 scale, rain data at the rain station in and/or around the catchment area, domestic water needs survey result and social-economy data in the related district/city.

Prerequisites : Hydraulics

Text Books References:

1. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wesley Publishing Company, USA.
2. Chow, Ven Te, 1959. Open-Channel Hydraulics. International Student Edition. McGraw-Hill Kogakusha, Ltd., Tokyo.
3. Chow, Ven Te, Maidment, David R. and Mays, Larry W., 1988. Applied Hydrology. McGraw-Hill Book Company, Singapore.
4. Dewberry, Sidney O. and Rauenzahn, Lisa N., 2008. Land Development Handbook: Planning, Engineering, And Surveying / Dewberry. Third edition. McGraw-Hill, USA. E-Book
5. Mays, Larry W., 1996. Water Resources Handbook. McGraw-Hill, USA.
6. Wanielista, M., Kersten, R. and Eaglin, R., 1997. Hydrology: Water Quantity and Quality Control. Second Edition. John Wiley & Sons, Inc., Canada.
7. Internet:
8. http://www.powershow.com/view1/10412d-ZDc1Z/Watershed_Delineation_powerpoint_ppt_presentation#5
9. Maine Stream Team Program of the Maine Department of Environmental Protection Stream, 2009. Survey Manual. A CITIZEN'S GUIDE to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds — Volume I. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Maine_water_survey-manual_appendix.pdf
10. The USDA Natural Resources Conservation Service. How to Read a Topographic Map and Delineate a Watershed. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Delineate_watersheds_NH_NRCS.pdf

ENCV615005

Ethics and Construction Law

2 Credits

Learning Outcomes :

1. Students will be able to explain ethics and morality in civil engineering profession and able to apply the knowledge in analyzing the impact when ethics is not applied;
2. Be able to explain the legal aspect and contracts in a construction project.

Competencies in curriculum : WA6 (engineer in society), WA8 (ethics)

Syllabus : Ethics and morals definition; Ethics theory; Work Ethics; Construction business ethics; Ethics towards environment; Law and regulation in construction works; Legal aspect of the dispute in construction works; Construction contracts

Prerequisites : Construction Management

Text Books References:

1. Mike W. Martin & Roland Schinzinger, Ethics in Engineering, McGraw Hill, 2005
2. Chow Kok Fong, Law and Practice of Construction Contracts, Sweet & Maxwell Asia, 2012
3. Nazarkhan Yasin, Kontrak Konstruksi di Indonesia, Gramedia Pustaka Utama, 2014

ENCV616001

Concrete Structure 1

3 Credits

Learning Outcomes :

1. Students will be able to explain design concept of structures, load applied on structures, structural systems;
2. Be able to design structural members from reinforced concrete according to procedures and design standards including beams, T beams, one way and two-way plate, short column and shallow foundation;
3. Be able to describe design results in engineering drawing in accordance to the rules and regulations of engineering drawing.

Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA10 (communication skill)

Syllabus : Introduction to structural system analysis and design; structural systems: purposes, design step; LRFD, reduction factor and allowable stress; loads and loading: Load forms, load types; location of loads, load distribution, load factor and load combination; basic concept of reinforced concrete; Steel and concrete stress-strain properties; Concrete compressive strength characteristic; Concrete compressive strength evolution; Ultimate strength concept, Whitney tensile block simplification, impartial collapse; Reinforcement analysis of single and double reinforcement on a regular beam; analysis of reinforcement for a T-beam section due to internal flexural moment forces; analysis of shear reinforcement for beam and torque reinforcement; analysis of one-way plate reinforcement, two-way plate with method coefficient method, analysis for short column reinforcement; foundation types and local shallow foundation designs with its drawing; able to calculate the deflection of a reinforced concrete structure.

Prerequisites : Construction Drawing, Building Construction, Solid Mechanics and Material Properties

Text Books References :

1. *Persyaratan Beton Struktural Untuk Bangunan Gedung*, SNI 2847 : 2013
2. *Beban Minimum Untuk Perancangan Bangunan Gedung Dan Struktur Lain*, SNI 1727 : 2013
3. MacGregor, J.G., Reinforced Concrete: Mechanics and design, 6th edition, Pearson, 2012

4. Wahyudi, Syahril A.Rahim, *Struktur Beton Bertulang*, Penerbit Gramedia, 1997

ENCV616002

Pavement Design

3 Credits

Learning Outcomes :

1. Students will be able to create a pavement design by recognizing the type of pavement and pavement damage with the ways of handling it, road pavement structure with mixture of asphalt concrete and cement concrete with tests in laboratory;
2. Be able to use HDM (highway design manual) software as a tool in the designing process.

Competencies in curriculum : WA 1 (engineering knowledge), WA2 (problem analysis), WA3 (design) and WA5 (modern tool usage)

Syllabus : Introduction to the history and development of highway design technology; Highway construction Norm, Standards, Rules and Manual; Type of pavement construction, Function of each layer of pavement; Basic soil road stabilization, type of material and test method as well as its use; Road pavement material test and quality test method; Mix Design and Mix test plan, paired with test activity in the laboratories; Introduction to asphalt mixing plant (AMP) – Types of and operating procedures; Design criteria and several analytical and empirical design method; Flexible pavement thickness design using AASHTO methods and component analysis (Bina Marga), staged construction and recoating construction; Rigid pavement design, joints method; Highway maintenance strategy, Type of road damages and how to detect it, as well as on how to repair it.

Prerequisites : Material Properties

Text Books References :

1. Direktorat Jenderal Bina MArga, (2013), *Manual Desain Perkerasan Jalan no 02/M/BM/2013,* Kementerian Pekerjaan Umum.
2. Huang, Y., 2004. Pavement Analysis and Design 2nd ed., Prentice-Hall, Inc.

3. *Petunjuk Desain Drainase Permukaan Jalan* (1990) Direktorat Jendral Bina Marga

4. AASHTO, 2007. Maintenance Manual for Roadways and Bridges. 4th Ed., American Association of State and Highway Transportation Officials

ENCV616003

Water Engineering 2

3 Credits

Learning Outcomes :

1. Students will be able to evaluate the implication of changes in spatial hypothetic of Case-DTA, to the planned flood debit value and the dimension of a related water infrastructure, by using hydrology model of WinTR-20 (C5);

2. Be able to self-organize when work independently or in a group, so the students can demonstrate the ability to master the course in the form of systematic written documents and an effective and efficient oral presentation (A4);
3. Be able to operate ArcGIS geospatial model to prepare data for hydrology model WinTR-20 (P3).

Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA5 (modern tool usage), WA6 (engineer in society), WA7 (environment & sustainability), WA9, (team work) and WA10 (communication skill)

Syllabus : Using hydrology model assisted with geospatial model to evaluate the impact of spatial changes on a water catchment area with area not exceeding 50 Km^2, and present the result in a form of a systematically written paper and effective oral presentation. The learning method consists of introductory lecture, individual/group exercises in and out of the class, as well as presentation and writing paper as a group final project. The final project consists of a task to use the ArcGIS geospatial model to prepare hydrological model input data for WinTR-20 that used to simulate the connection between rain and flow of water influenced by the changes of the spatial changes on a water catchment area. The Evaluation is focused on the impact of the changes on water catchment area towards the amount of planned flooding debit value which will impact the dimension of related water structure.

Prerequisites : Water Engineering 1

Text Books References:

1. John E. Gribbin, 2014, Introduction to Hydraulics and Hydrology with Applications for Storm Water Management, Fourth Edition
2. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wesley Publishing Company, USA.
3. Chow, Ven Te, 1959. Open-Channel Hydraulics. International Student Edition. McGraw-Hill Kogakusha, Ltd., Tokyo.
4. Chow, Ven Te, Maidment, David R. and Mays, Larry W., 1988. Applied Hydrology. McGraw-Hill Book Company, Singapore.
5. Dewberry, Sidney O. and Rauenzahn, Lisa N., 2008. Land Development Handbook: Planning, Engineering, And Surveying / Dewberry. Third edition. McGraw-Hill, USA. E-Book
6. Mays, Larry W., 1996. Water Resources Handbook. McGraw-Hill, USA.
7. Wanielista, M., Kersten, R. and Eaglin, R., 1997. Hydrology: Water Quantity and Quality Control. Second Edition. John Wiley & Sons, Inc., Canada.
8. http://www.powershow.com/view1/10412d-ZDc1Z/Watershed_Delineation_powerpoint_ppt_presentation#5
9. Maine Stream Team Program of the Maine Department of Environmental Protection Stream, 2009. Survey Manual. A CITIZEN'S GUIDE to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds — Volume I. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Maine_water_survey-manual_appendix.pdf
10. The USDA Natural Resources Conservation Service. How to Read a Topographic Map and Delineate a Watershed. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Delineate_watersheds_NH_NRCS.pdf

ENCV616004

Construction Management

2 Credits

Learning Outcomes :

1. Students will be able to apply process and concept of construction management in analyzing the step of planning, executing and handover stage of a construction project;
2. Be able to apply process and concept of construction management in planning and executing project by considering cost, time and quality aspect of the project;
3. Be able to explain administration of contracts related to a construction project;
4. Be able to use MS Project software as a tool in project planning.

Competencies in curriculum : WA5 (modern tool usage), WA11 (project management & finance)

Syllabus : Construction project knowledge including: Project Planning; Bidding documents preparation; Contract administration; Construction planning; Construction execution methods; Monitoring and Controlling; Material Management; Quality Management; Project Cost Management; Time Management; Safety, Health and Environment; Resource and Stakeholder Management.

Prerequisites :

- Pass these following courses: Construction Drawing; Building Construction; Material Properties
- This course is taken in conjunction with Methods and Equipment Construction Course

Text Books References :

1. Kerzner, Harold, Project Management, John Wiley & Sons, Inc., 2006
2. Project Management Institute, A Guide to Project Management Body of Knowledge, 2013

3. European Construction Institute, Total Project Management of Construction Safety, Health and Environment, Thomas Telford, London,1995
4. Clough, R. H., Sears, G. A. and Sears, S. K., Construction Contracting, 7th ed., John Wiley & Sons Inc., New York, 2005

5. Holroyd, T. M., Site Management for Engineers, Thomas Telford, London, 1999

6. Michael T. Callahan, Daniel G. Quakenbush, and James E. Rowing, Construction Planning and Scheduling, McGraw-Hill Inc., New York, 1992.

7. Gould, F. E. Managing the Construction Process (Estimating, Scheduling and Project Control)., Prentice Hall., New Jersey, 1997

8. Halpin, D., W., Construction Management. USA, John Wiley and Sons, Inc., New York, 1998

9. Hendrickson, C., Project Management for Construction. Fundamental Concepts for Owners, Engineer, Architects, and Builders., Prentice Hall, Singapore, 2008

10. Barrie, D. and Paulson B., Professional Construction Management, McGraw Hill, New York, 1992

ENCV616005
Construction Methods and Equipment
2 Credits
Learning Outcomes :
1. Students will be able to calculate the capacity and cost of a heavy construction equipment, able to analyze the character, type and volume of the works;
2. Be able to calculate and plan an execution process of soil displacement using heavy construction equipment by considering the principal of construction management in calculating the cost aspect;
3. Be able to work together in a team.

Competencies in curriculum : WA3 (design), WA9, (team work) and WA11 (Project management & finance)
Syllabus : Definition of mechanical earth moving, characteristic, type of soil and soil volume, operation of heavy equipment, capacity and production cost of heavy equipment, calculate work volume, determine the equipment needs, designing to combining equipment for optimization times and cost; Calculate production of heavy equipment, the way to work of each heavy equipment, the way to planning project. Several ways to calculate volume of cut and fill, construction method, calculation of the work schedule and related cost.
Prerequisites : Surveying and Basic Soil Mechanics
Text Books References :
1. Imam Sugoto. 1980. *Mempersiapkan Lapisan Dasar Konstruksi Jilid 1.* Jakarta: Departemen Pekerjaan Umum.

2. Imam Sugoto. 1980. *Mempersiapkan Lapisan Dasar Konstruksi Jilid 2.* Jakarta: Departemen Pekerjaan Umum

ENCV617001
Capstone Project
3 Credits
Learning Outcomes : The students will be able to produce civil engineering building design with detailed engineering design, simulated as a work ready to be executed using basic civil engineering combined with economic analysis and tender documents complete with shop drawing.
Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA5 (modern tool usage), WA6 (engineer in society), WA7 (environment & sustainability), WA8 (ethics), WA9 (team work) and WA10 (communication skill)
Syllabus : Identification of problems in accordance with the work terms of reference; Planning component negotiations associated with the scope of work and execution time; Formulation of the main and secondary civil engineering structural component as an analysis material; Arranging analysis report consist of design concept, calculating and execution methods, by applying rules, manuals and standards. ; Arranging civil engineering construction component specification according to the rules and technical specification, Calculation of unit price and bill of quantity, details of the overall cost of the job, and detail drawing for main components according to the standard and technical provisions.
Creating a Blue Print as a results of structure calculation in the form of a shop drawings that are ready to be executed by contractors.
Prerequisites : -
Text Books References :

1) SNI (*standar tata cara perhitungan struktur beton untuk bangunan gedung; standar tata cara perencanaan struktur baja untuk bangunan gedung; standar tata cara perencanaan ketahanan gempa bangunan gedung, dan standar yang dikeluarkan oleh Kementerian PU*)
2) ASTM (American Standard for Testing Material)
3) AISC (American Institute of Steel Construction)
4) The American Concrete Institute' (ACI)
5) ASCE 07-2010 – Minimum Design Load for Building and other structures
6) British Standards
7) Technical Standards for Port and Harbor in Japan
8) FAA (Federal Aviation Administration)

ENCV610001
Internship
3 Credits
Learning Outcomes :

1. Students will be able to observe the application of theoretical civil engineering knowledge in an execution process of a construction project;
2. Be able to observe the application of professional ethics during the execution of a construction project;
3. Be able to apply a part of engineering economics principal and construction management in analyzing the execution of a construction projects;
4. Be able to identify problems that emerge during the execution of the construction project and solution decision process, able to analyze solution options according to the existing theory and able to criticize if there is an incompatibility as well as able to give solution that should be taken according to the existing theory;
5. Be able to read engineering drawing and see the similarities between the engineering drawing and the realization in the construction projects;
6. Be able to write field observation result in a form of an internship report and able to present it in front of the examiner team.

Competencies in curriculum : WA6 (engineer in society), WA7 (environment & sustainability), WA8 (ethics), (WA9, (team work), WA10 (communication skill) and WA11 (project management & finance)
Syllabus : Implement an internship in a construction project, field observation; interpret a construction drawing, writing an observation report, describing a technical work process, quality control, project management, project specification, engineering drawing and other aspect; problem solving on the fields, presenting an internship reports
Prerequisites :

1. Already pass 6th semesters and pass $\geq$ 75 credits according to the determined conditions applied by the Civil Engineering Department, Faculty of Engineering, Universitas Indonesia and/or the conditions from Faculty of Engineering, Universitas Indonesia
2. Registered and fill out IRS for internship special course, and expresses him/herself to the Internship Coordinator in the Department of Civil Engineering
3. Student choose a project and / or object of selected activities at the internship site and location that has been contracted previously
4. Students must complete and submit the registration form at the Secretariat of Civil Engineering Department

Text Books References : -

ENCV610002
Seminar
1 Credit
Learning Outcomes :

1. Students will be able to implement the civil engineering knowledge on formulating a problem in the field of civil engineering, conducting a literature studies and formulate a research hypothesis and methodology to solve the problem;
2. Be able to write a study proposal in a scientific writing using a proper Indonesian/English language and following the standard of seminar and undergraduate thesis format and present it to the examiner team;
3. Be able to work independently and complete the work within the time limit.

Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA5 (modern tool usage), WA6 (engineer in society), WA7 (environment & sustainability), WA9, (team work) and WA10 (communication skill), WA12 (lifelong learning)
Syllabus : Developing problem description, Literature study, constructing research methodology, conducting an initial study, preparing and presenting a well-structured and well-written final report

Prerequisites : Passing 110 credits with GPA >=2.00 and without grade of E
Text Books References: -

ENCV 618 001
Entrepreneurship
2 Credits
Learning Outcomes : The students will be able to explain the comparison among wide types of civil engineering entrepreneurship characterized by innovation and independency which based on ethics as well as able to communicate it both visually and orally.
Competencies in curriculum : UIe (entrepreneurship), WA6 (engineer in society), WA9, (team work), and WA10 (communication skill)
Syllabus : Problems and needs from the various stakeholders in the field of civil engineering, General options for entrepreneurship to solve civil engineering problems, Entrepreneurship definition, Businessman Action, Plan and Challenges; Action, Academics and observer challenge and plan, Canvas model Business Concept, General Company Profile, General customer profile, Cost and Turnover, Differences and similarities identification between BMC components, Advantages and disadvantages assessment from each of the BMC components, Various environmental engineering product and services, Definition of product value, Human Needs, Customer segments, Various customer profiles, Knowing the customer profile method, Knowing the customer profile, Differences and similarities identification between VPC components, Advantages and disadvantages assessment from each of the VPC components
Prerequisites : MPKT A, Introduction to Civil Engineering System
Text Books References: -

ENCV610003
Final Project
4 Credits
Learning Outcomes:
1. Students will be able to apply civil engineering knowledge to solve a complex civil engineering problem through a study that follows the research rules such as: Conducting a literature study, choosing the research methodology, analyze and interpret the data and draw a valid conclusion;
2. Be able to write the result of the research in a scientific writing using the correct Indonesian/English language and following the standard final project format;
3. Be able to present the study result to the examiner team;
4. Be able to work independently and complete the work within the time limit.

Competencies in curriculum : WA2 (problem analysis), WA3 (design), WA5 (modern tool usage), WA6 (engineer in society), WA7 (environment & sustainability), WA9, (team work) and WA10 (communication skill), WA12 (lifelong learning)
Syllabus : Problem formulation, Literature study, conducting research, data analysis, result interpretation, preparing a written report of the synthesis and present the study results
Prerequisites : Passing 110 credits with GPA >=2.00 and without grade of E
Text Books References: -

Elective Courses Syllabi

ENCV 617 002
Civil Engineering System
3 Credits
Learning Outcomes:
1. Students will be able to create basic design and proposal for alternative plans or solutions to the problems of civil engineering based on formulation of problems encountered with literature review and field surveys;
2. Students will be able to find the optimal solution for a simple problem in Civil Engineering with a systematic approach through the stages of problem solving techniques (engineering). (C4) /(A3).

Competencies in Curriculum: WA2 (problem analysis), WA9 (team work) and WA10 (communication skills)
Syllabus: The role and function of professional undergraduate Civil Engineering, Process for solving engineering problem, System approach, Systems characteristic in engineering problem, Understanding the characteristics of the problem, Statement of Needs, System hierarchy, Scope and limitation, Systems Analysis, Solutions approach, The role of modeling, Type of modelling, Linear Graph modeling concept, Mathematical modeling concept, Process optimization, Motivation and freedom to choose, Purpose, Objectives and Criteria for optimization, Optimization

Methods, Feasibility studies, Planning horizon. Time Value of Money, method of Economic Analysis, Financial Analysis, Element of decision problems, Decision models, Basic Probability, Decision Analysis by Value Utilities.
Prerequisites: Introduction to Civil Engineering System
Text Book References:

1. Dale D Meredith, Kam W Wong, Ronald W Woodhead, Robert H Worthman (1975), Design & Planning of Engineering Systems, Prentice Hall
2. C Jotin Khisty, Jamshid Mohammadi, (2001), Fundamental of System Engineering with Economics, Probability, and Statistics, Prentice Hall
3. M David Burghardt, (1999), Introduction to Engineering Design and Problem Solving, McGraw Hills.

ENCV 617 003
Sustainable Build Environment
3 Credits
Learning Outcomes: Students will be able to apply the basic principles of natural and manmade environmental system and the meaning of sustainable development in engineering activities to be able to design civil engineering buildings with the concept of green building and environmental friendly.
Competencies in Curriculum: WA2 (problem analysis), WA7 (environment and sustainability)
Syllabus: Basic Principles of natural environmental systems and life cycle (cycle of matter and energy, hydrological cycle, food chain); Basic Principles of manmade environment and the impact on the natural environment system and life cycle (social system, ecosystem, build environment; niche concept, carrying capacity and resilience); Construction and infrastructure sector impact on the natural environment; 21 Agenda and Environmental Based Construction (Global agenda / national / local, social-economic, and the environment pillar in construction); The concept of Civil Engineering environment (zero waste, efficiency, waste management hierarchy, waste-pollution and carrying capacity of the environment, sustainable consumption and production); The concept of Green Building (LEED); Criteria for Green Building; Sustainable sites (EIA); Water efficiency; Energy and atmosphere; Materials and natural resources; Innovation and design process; Strategy Conception for Green Building; Examples of Green Building concept in Indonesia and other States; Laws and other regulations in Environmental Affairs, ISO 14001.
Prerequisites: -
Text Book References: -

ENCV 617 004
Concrete Structure 2
3 Credits
Learning Outcomes:

1. Students will be able to design structural component: columns, portals, with the ultimate strength method due to force from latitude bending moment, normal moment, torque and its combination in accordance to the aspect of service life according to SNI 2847: 2013; able to design a two-way slab without beams, short consoles, as well as understand the application of strut and tie models;
2. Students will be expected to plan a simple pre-stressed concrete structures, according to SNI 2847: 2013.

Competencies in Curriculum: WA2 (problem analysis), WA3 (design), WA10 (communication skills)
Syllabus: Analysis of shear and torsion; Meaning of bond stress, Termination/cutting of reinforcement steel and length of reinforcement distribution; Serviceability: Analysis of deflection on reinforced concrete structures; Analysis of crack width; Analysis of reinforcement in reinforced concrete slender columns; Biaxial bending; Analysis of P-δ effect; Analysis of shear reinforcement in columns; Planning of continuous foundation and deep foundations in reinforced concrete; Floor system analysis: two-way slab with and without beam, direct design and the equivalent frame; Understanding the basis for planning and application of reinforced concrete portals; Examination of the relationship between the beams and columns; Corbel and placement; Analysis of Strut and Tie modeling; The basic concept of pre-stressed concrete structures, All kinds of pre-stressed concrete structures, Stage for pre-stress force, Material characteristics, Pre-stressed and anchorage system, Loss of pre-stressed force; Cross-section analysis with elastic method and strength limits for monoliths and composites cross section; Planning of pre-stressed cable cross section due to bending; Analysis of shear stress, Deflection analysis on pre-stressed concrete structures.
Prerequisites: Concrete Structure 1
Text Book References:

1. *Persyaratan Beton Struktural Untuk Bangunan Gedung*, SNI 2847: 2013
2. *Beban Minimum Untuk Perancangan Bangunan Gedung Dan Struktur Lain*, SNI 1727: 2013
3. MacGregor, J.G., Reinforced Concrete: Mechanics and Design, 6th. Edition, Pearson, 2012
4. Nawi, E.G. Reinforced Concrete: A Fundamental Approach, 6th. edition, Pearson, 2009
5. Wang C.K. and Salmon C.G., Reinforced Concrete Design, Harper Collins, 1992

Lin, T.Y & Burns, N.H., Design of Pre-Stressed Concrete Structures, Third Edition, John Wiley & Sons, 1981

ENCV 617 005
River Engineering
3 Credits
Learning Outcomes: Students will be able to predict and describe (C5) systematically both in oral and in writing, the influence of interactions among various factors of hydrological, hydraulic and river morphology to the behavior of river and if there are problems may propose solutions (A5) with taking into account the technical and environmental aspects.
Competencies in Curriculum: WA2 (problem analysis)
Syllabus: Knowledge on how the flow of the river is formed from the river hydrology point of view, River hydraulics and morphology of the river, as well as what problems are caused by changes in river flow due to the nature of the flow and sediment transport, so as too able to predict, analyze and criticize the influence of the local system flow in relation to construction of buildings along the river and river controlling structure.
Prerequisites: Water Engineering 1
Text Book References:

1. Jansen, P.Ph. · Van Bendegom, L. · Van den Berg, J. · De Vries, M. · Zanen, A., 1994, Principles of river engineering: the non-tidal alluvial river, Delftse Uitgevers Maatschappij, Netherland
2. Prins A., 1979. Rivers. Lecture Notes (Unpublished). International Institute for Hydraulics Engineering, Delft, The Netherland
3. Chow, Ven. Te et.al., 1988: Applied Hydrology. McGraw-Hill Book Company
4. Chow, Ven. Te et.al., 1959. Open-Channel Hydraulics. McGraw-Hill Kogakusha.
5. Henderson, F.M., 1966: Open Channel Flow. MacMillan, New York
6. French R.H., 1985: Open-Channel Hydraulics. McGraw-Hill Book Company
7. Bedient P. B. and Huber W.C., 1992: Hydrology and Floodplain Analysis. 2nd ed. Ch.3-5. Addison-Wesley Publishing Company, USA
8. Doelhomid Srimoerni W.S., 1977: Sungai. Diktat Kuliah (tidak dipublikasikan). IMS FTUI, Jakarta
9. R. J. Garde, 2006, River Morphology, New Age International (P) Limited, Publisher

ENCV 618 002
Steel Structure 2
3 Credits
Learning Outcomes:

1. Students will be able to calculate the connection strength in steel structure and proportioning the connection using plastic and elastic method;
2. Be able to calculate and proportioning girder plate structure, portals and composite structure in a simple multi-stories building using elastic and plastic method.

Competencies in Curriculum: WA2 (problem analysis), WA3 (design)
Syllabus: Calculation of continuous beam by plastic method; Beam-columns; Theory and Analysis of girder plate on building; Advance connection techniques; The design of the portal and gable frame; Structural Analysis; Steel-steel and steel-concrete composite structures in simple multi-stories buildings; Concrete pre-stressed steel composite structure and implementation of Perplex systems in buildings; Cold form section / Light Gage Member.
Prerequisites: Steel Structure 1
Text Book References:

1. Spesifikasi untuk Bangunan Gedung Baja Struktural; SNI 1729: 2015
2. Segui, William T., Steel Design,5th edition, 2013
3. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 1
4. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 2
5. Structural Steel Design, Prentice Hall, 2012

ENCV 618 003
Construction Methods in Geotechnics
3 Credits
Learning Outcomes: Students will be able to design construction method of a geotechnical construction component with considering the economic, environmental, social, ethical, health, safety, constructability, and sustainability factor.

Competencies in Curriculum: WA2 (problem analysis), WA3 (design), WA7 (environment and sustainability)
Syllabus: Construction method of deep foundation and retaining wall, and factors that influence the method of selection, Method of testing the integrity of deep foundations; Method of basement construction, Excavation strengthening, dewatering, and factors that influence the selection of method; Construction method of embankment on soft ground, PVD, Preloading, Vacuum preloading, and the factors that influence the selection of method; Geo-synthetic usage in geotechnical construction.
Prerequisites: Basic Soil Mechanics, Soil Mechanics, Foundation Engineering
Text Book References:

1. Chai, J. and Carter, J.P. (2011). Deformation Analysis in Soft Ground Improvement, Springer.
2. Hertlein, B.H. and Davis, A.G. (2006). Nondestructive Testing of Deep Foundations, John Wiley.
3. Koerner, R.M. (2005). Designing with Geosynthetics, 5th Ed., Prentice Hall.
4. Ou, C.-Y. (2006). Deep Excavation: Theory and Practice, Taylor and Francis, London.
5. Tomlinson, M. J. and Woodward, J. (2008). Pile Design and Construction Practice, 5th ed., Taylor and Francis.

ENCV 618 004
Stormwater Management
3 Credits
Learning Outcomes:

1. Students will be able to assess the effectiveness of the management of rain in an existing Region Case (RC) which is a developed region in urban areas, based on the comparison of the evaluation results from the performance of existing drainage systems in existing RC, and performance evaluation of the proposed rain management model by using Low Impact Development (LID) and Water Balance Model (WBM), using a hydrological model WinTR-55 aided with of ArcGIS geospatial model (C5);
2. Be able to organize every individual to work independently and in groups, so as to demonstrate the mastery of the course competencies in the form of a systematic written document and effective and efficient oral presentations (A4).

Competencies in Curriculum: WA2 (problem analysis), WA3 (design)
Syllabus: Utilizing a deterministic hydrology model aided with geospatial model to evaluate the performance of drainage systems that exist in a developed region in urban areas, and making proposals to the management system of rain by using Low Impact Development (LID) models and Water Balance Model (WBM), as well as evaluating the performance of the proposed design by utilizing the same hydrological and geospatial models. The result is presented in a systematic written document and an effective and efficient oral presentations. Learning method consists of introductory lectures, group discussions inside and outside the classroom, written/oral exam, oral presentation and final papers.
Prerequisites: Water Engineering 1
Text Book References:

1. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wesley Publishing Company, USA.
2. Chow, Ven Te, 1959. Open-Channel Hydraulics. International Student Edition. McGraw-Hill Kogakusha, Ltd., Tokyo.
3. Chow, Ven Te, Maidment, David R. and Mays, Larry W., 1988. Applied Hydrology. McGraw-Hill Book Company, Singapore.
4. Dewberry, Sidney O. and Rauenzahn, Lisa N., 2008. Land Development Handbook: Planning, Engineering, And Surveying / Dewberry. Third edition. McGraw-Hill, USA. E-Book
5. The Douglas College Institute of Urban Ecology, British Columbia. The Water Balance Model: A Tool for Designing with Nature. Douglas College Rain Conference. www.waterbalance.ca
6. Kim A. Stephens, Patrick Graham and David Reid, 2002. Storm water Planning: A Guidebook for British Columbia. Ministry of Water, Land and Air Protection. British Columbia, Canada.
7. Low Impact Development (LID) Urban Design Tools. http://www.lid-stormwater.net/
8. NRCS and ARS, 2003. WinTR-55: User Guide.
9. NRCS and ARS. WinTR-55: Tutorial.
10. Panduan Pelatihan ArcGIS.

Urban Planning and Sanitation
3 Credits
Learning Outcomes:

1. Students will be able to explain the role of civil engineer in setting up the infrastructure needed in an urban

area and be able to apply that knowledge in the process of planning, monitoring and implementation of the regional arrangement;
2. Be able to describe the components of an urban sanitation techniques and applying that knowledge in the planning, monitoring and implementation so as to create environmentally sustainable region.

Competencies in Curriculum: WA2 (problem analysis), WA7 (environment and sustainability)
Syllabus: Definition and function of urban planning, Primary factor in urban planning, Population aspect in urban planning, Social facilities and forms of urban development, Land use, Water management and its relationship with land use. Controlling transmission of infectious and non-infectious diseases in an area, Planning and analyzing impacts of environmental engineering, Clean water supply, Waste water treatment and disposal, Solid waste management, Noise control, Air pollution control.
Prerequisites: -
Text Book References:

1. Hamid Shirvani, Urban Design Process, New York, Van Nostrand Reinhold Co, 1987
2. Ali Madanipour, Design of Urban Space: An Inquiry into a Socio-Spatial Process, John Wiley and Sons, 1996
3. Gideon S. Golany, Ethics and Urban Design: Culture, Form and Environment, Wiley, 1995
4. Environmental Engineering and Sanitation: Joseph A Salvato: John Willey & Son, Inc., Canada
5. Environmental Science and Engineering, J. Glynn Henry and Gary W. Heinke, Prentice Hall International Inc.

Environmental Impact Analysis and ISO
3 Credits
Learning Outcomes: Students will be able to apply the method of EIA and environmental audits as inputs for safeguards against human and natural resources.
Competencies in Curriculum: WA2 (problem analysis), WA7 (environment and sustainability)
Syllabus: The meaning of EIA, EIA process and benefits, rules, regulations and management of EIA, Environmental settings, Estimation of environmental impacts, Environmental impact to the physical, chemical, biological, socio-economic, and socio-cultural sector. EIA method, Method and techniques of identification, prediction, evaluation and interpretation of the EIA, Environmental Monitoring Plan, Environmental Management Plan, Environmental Audit and Environmental Management System.
Prerequisites: -
Text Book References:

1. Canter, L.W., Environmental Impact Assessment, New York, McGraw-Hill, 1996.
2. Kuhre W. Lee., *Sistem Manajemen Lingkungan*, Jakarta, Prenhallindo, 1996.
3. "ISO 14000 *Sistem Manajemen Lingkungan*" by Brian Rotherry (1996)
4. Soemarwoto, Otto, *Analisis Mengenai Dampak Lingkungan*, Yogyakarta, Gadjah Mada University Press, 2007