Wrocław
University
of Technology

Master Program

Civil Engineering

Faculty of Civil Engineering

SYLLABUS OF COMPULSORY COURSES

Description of the courses – compulsory courses

1st semester

CODE CEB3161	**COMPUTER AIDED ENGINEERING**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Basic knowledge of structural mechanics, concrete and steel structures design.				**Teaching: Traditional**/Distance L.	
Lecturer: Piotr Berkowski, PhD, Andrzej T. Janczura, PhD, Jerzy Szołomicki, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)			30		
Exam / Course work/T:			T		
ECTS			2		
Workload (h)			60		

Outcomes: Students gain knowledge on modeling and designing of different 2D and 3D building and civil engineering structures using computer programs. Students gain understanding of theoretical basis of structural modeling, algorithms and procedures of computer design programs, and also knowledge on interpretation and verification of results as well. Students get ability in application and choosing computer programs to solve practical design problems for different types of structures.

Content: Training on computer programs (Robot, Lusas) used to solve design problems. Presentation of elements of computer modeling (FEM) of complicated engineering structures (workshops, roof structures, chimneys, towers, masts, frameworks, historical masonry buildings). Overworking of models, structural calculations, and dimensioning of selected object treated as a whole structure (problems associated from other courses). Examples of applied optimization of structures and structural elements (Solver/Robot/Evolve).

Literature:

1. Zienkiewicz O. C., Taylor R. L., Zhu J. Z., The Finite Element Method, Sixth Edition, McGraw-Hill, 2005.
2. McCormack J., Structural Analysis Using Classical and Matrix Methods, John Wiley & Sons, 2007.
3. Arora J. S., Optimum design, McGraw-Hill, Inc., 1989 (ex.).
4. Program manuals (Robot, Lusas).

Description of the courses – compulsory courses

1st semester

CODE CEB5061	**GEOENGINEERING – FOUNDATIONS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Włodzimierz Brząkała, PhD, DSc, Associate Professor, Jarosław Rybak, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work/T:	T			T	
ECTS	3			2	
Workload (h)	60			60	

Outcomes: The course extends the scope of the graduate course foundations focusing on presentation of the selected new geoengineering technologies and corresponding calculation techniques. Designs complete the contents of the lecture towards geoengineering practice. The design projects cover an elastic analysis of soil-foundation interaction (foundation beam, pile groups) and limit states of stresses in soils (earth pressure, retaining structures). Students get the background to deal with more advanced problems of geoengineering.

Content: Soil-foundation interaction problems in terms of calculation and design of simple deformable foundations as well as stiff constructions (foundation beams and plates resting on elastic subgrade, piles, block foundations). A special attention is paid to foundations exposed to mining influences, surface protection aspects characteristic for mining areas, dynamical excitations of soils and block foundations of machines. Retaining and embedded constructions are also considered making use of a wide spectrum of earth pressure theories. Types, properties and applications of reinforced soils and soil improvements are discussed. Supporting of deep excavations is presented including the application of slurry walls for underground constructions, the "Top & Down" method, secant-pile walls, soil anchors, etc. General criteria of safety and stability are defined following the guidelines of the Eurocode EC7: Geotechnical Design. A number of calculation examples is presented as well as relevant case histories, like the Pisa Tower and so on.

Literature:

1. Cernica J., Geotechnical engineering: Foundation design. John Wiley & Sons, 1995.
2. Henry J., Foundation Engineering, 1990.
3. Lancellotta R., Geotechnical engineering, A.A. Balkema, 1995.
4. Selvadurai A.P.S., Elastic analysis of soil-foundation interaction, Elsevier, 1979.
5. Eurocode EC7 – Geotechnical design.

Description of the courses – compulsory courses

1st semester

CODE CEB3361	**CONCRETE STRUCTURES**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Fundamental knowledge on concrete structures				**Teaching: Traditional**/Distance L.	
Lecturer: Jacek Dyczkowski, PhD; Janusz Pędziwiatr, PhD; Marek Maj, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	45			30	
Exam / Course work/T:	E			T	
ECTS	3			2	
Workload (h)	90			60	

Outcomes: Competence in designing of industrial houses and multi-storey buildings and designing of reinforced concrete and pre-stressed composing elements. Knowledge comprising principles of designing of complex reinforced concrete thin-walled constructions: wall-type beams, roofs, reservoirs and silos.

Content: Shaping and designing of industrial houses with overhead cranes and composing elements: roofs, pre-stressed solid-web and truss- girders, crane girders and columns. Outline of shaping and calculations of skeleton constructions of multi-storey industrial buildings, concrete frames and flat floors. Shaping and designing of reinforced concrete: wall-type beams, folded plate structures, domes, reservoirs and silos.

Literature:

1. Nawy E., Concrete Construction Engineering Handbook, CRC Press, 2008.
2. Limbrunner F., Aghayere A., Reinforced Concrete Design, Prentice Hall, 2007.
3. Raju N. K., Prestressed concrete, Mc Graw–Hill, 2008.
4. EN1992 Eurocode 2: Design of concrete structures.
5. EN1991 Eurocode 1: Actions on structures.

Description of the courses – compulsory courses

1st semester

CODE CEB3461	**METAL STRUCTURES**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Fundamental knowledge on steel structures				**Teaching: Traditional**/Distance L.	
Lecturer: Dawid Mądry, PhD; Jan Rządkowski, PhD; Wojciech Lorenc, PhD; Andrzej Kowal, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	45			30	
Exam / Course work/T:	E			T	
ECTS	3			2	
Workload (h)	90			60	

Outcomes: Acquainting with static behaviour and designing of steel industrial buildings and other steel structures with a special attention paid to the local and global stability of systems, methods of design and load combinations, structural system selections, reroofing and renovation of metal building systems.

Content: Steel bays with cranes, long-span structures, containers, chimneys, towers, masts, frame structures – primary framing single span and multispan frames; role of frame bracing, endwall framing, secondary framing (cold-formed steel purlins, cold-formed steel girts, hot-rolled steel girts).

Literature:

1. Gaylord E. H., Gaylord Ch. N., Stallmeyer J. E., Design of steel structures, McGraw-Hill International Editions, Civil Engineering Series 1992.
2. Newman A., Metal building systems, design and specifications, McGraw-Hill, New York, 1997.
3. Rules for Member Stability in EN 1993-1-1: Background documentation and design guidelines, 2006. *ISBN* 92-9147-000-84.
4. Buckling of Steel Shells - European Design Recommendations, 2008. ISBN 92-9147-000-92.
5. Worked examples according to EN1993-1-3, 2008. ISBN 92-9147-000-86.
6. The behaviour and design of steel structures to EC 3", Fourth Edition N-S. Trahair and others Taylor & Francis Group, London and New York, 2008.

Description of the courses – compulsory courses

1st semester

CODE CEB3561	**STRUCTURAL MECHANICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Strength of materials, introduction to structural mechanics				**Teaching: Traditional**/Distance L.	
Lecturer: Małgorzata Gładysz, PhD; Dariusz Łydżba, PhD, DSc, Associate Professor; Marek Kawa, PhD; Adrian Różański, MSc					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30	30	15		
Exam / Course work/T:	E	T	T		
ECTS	2	2	1		
Workload (h)	60	60	30		

Outcomes: Competences in modeling and analysis of civil engineering structures. Ability of analysis izo- and hyperstatic structures. Competences in analysis of structures response under moving forces.

Content: Modelling of civil engineering structures. Classification of structural models based on 1-, 2- and 3-dimensional elements. Mechanics of bar structures. Principle of virtual work, basic theorems, displacements of structures. Analysis of hyperstatic structures. Influence functions of static quantities: static and kinematic methods. Envelopes of static quantities and their application in design of structures.

Literature:

1. Przemieniecki S.,Theory of Structural Analysis, MacGraw-Hill, New York, 1968.
2. Meller M., English through civil engineering, Politechnika Koszalińska – Wydawnictwo Uczelniane, 1998.
3. Mase G.E., Theory and problems of continuum mechanics, New York, Mc Graw-Hill, 1970.
4. Ross C.T.F., Finite element methods in structural mechanics, 1985.
5. Reddy J.N., Applied functional analysis and variational methods in engineering, New York, Mc Graw-Hill, 1986
6. Pilkey W.D., Wunderlich W., Mechanics of structures. Variational and computational methods, CRC Press, Boca Raton, 1994.

Description of the courses – compulsory courses

1st semester

CODE CEB5161	THEORY OF ELASTICITY AND PLASTICITY				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits: strength of materials, structural mechanics				**Teaching: Traditional/**Distance L.	
Lecturer: Kazimierz Myślecki, PhD, DSc, Associate Professor; Grzegorz Waśniewski, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30	15			
Exam / Course work/T:	T	T			
ECTS	2	2			
Workload (h)	60	30			

Outcomes: Familiarization with Selected problems of the theory of elasticity: the rod stretched by dead load, the beam under bending moment and shear force. Torsion of the rod of elliptic cross section. Stresses and displacements. The adoption of polynomial method to the solution of slabs. Axisymmetric, circular and annular plates. Shells of revolution in membrane state. Calculation of internal forces and displacements.

Content: Spatial problem of the theory of elasticity, description of states of displacement strains and stresses, governing equations of the theory. Plane problem of the theory of elasticity. Plane problem in polar coordinates. Theory of thin plates. Solution of rectangular plates by means of trigonometric series. Circular and annular plates. Stability of rectangular plates. Principles of the shell theory. Shells of revolution in the membrane state.

Literature:

1. Washizu Kyuichiro, Variational methods in elasticity and plasticity, Pergamon Press, 1982.
2. Stephen P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill, 1970.
3. A.I. Lurie and A.K. Belyaev, Theory of Elasticity (Foundations of Engineering Mechanics), Springer, 2005.

Description of the courses – compulsory courses

1st semester

CODE CEB3761	**MATHEMATICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (1)	**Level:** II			**Compulsory**/Optional	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Wojciech Puła, PhD, DSc, Associate Professor; Andrzej Janczura, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30	15			
Exam / Course work/T:	E	T			
ECTS	2	2			
Workload (h)	60	60			

Outcomes: Repetition of the basic theory of ordinary differential equations, Selected topics on partial differential equations. Examples that are oriented towards applications in structural mechanics and geotechnics.

Content: Ordinary differential equations – repetition of basic ideas. Some elementary examples. Basic types of the first order differential equations: separation of variables, homogeneous equations, linear homogeneous and nonhomogeneous equations (variation of constant method, method of undetermined coefficients). Ordinary linear equations of higher orders. Homogeneous equations, fundamental sets of solutions. Non-uniform equations: the method of constant variation, method of undetermined coefficients. Applications of linear differentia equations to structural mechanics: equation of a beam resting on the Winkler subsoil, equation of a pile subjected to lateral load. Examples of system of ordinary differential equations. Selected problem of mechanics leading to partial differentia equations: Terzagi's consolidation, vibrating string. Basic definitions of partial differentia equations. Types of boundary value problems with examples. Simplest methods of integrating partial differential equations. Transport equation with constant coefficients. Laplace's equation and fundamental solution. Harmonic functions, potentials, the maximum principle. The heat conduction equation and its fundamental solution. The wave equation and the d'Alembert formula. Separation of variables. Boundary problems associated with hyperbolic equations. An application of hyperbolic equations to bearing capacity evaluation. Basic ideas of approximate methods. The methods of characteristics, the finite element method.

Literature:

1. Agarval R. P., O'Regan D., An ntroduction to Ordinary Differential Equation, Springer, 2008.
2. Evans L. C., Partial differential equations, Graduate Studies in Mathematics, American Mathematical Society, 1998.
3. Churchill R.V., Brown J. W., Fourier Series and Boundary Value Problems, McGraw-Hill Book Company, New York, 1978.

Description of the courses – compulsory courses

2nd semester

CODE CEB3862	**HYDRAULICS IN CIVIL ENGINEERING**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Physics, mathematics				**Teaching: Traditional**/Distance L.	
Lecturer: Jerzy Machajski, PhD; Stanisław Kostecki, PhD, DSc					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work/T:	T			T	
ECTS	1			2	
Workload (h)	60			30	

Outcomes: Students gain knowledge on basic hydraulics of open and closed conduits. Students gain understanding of theoretical basis of water motion, and procedure of solving different problems in civil engineering associated with water influence. Students get ability in application and option of computer programs to solve design practical problems of different hydro-engineering and civil-engineering structures.

Content: Hydrostatic pressure. Hydrostatic pressure force and buoyancy. Fundamental hydrodynamics equations. Types of fluid motions. Equations of continuity and uniform motion. Designing of open channels, hydraulically advisable channel, sewage systems. Calculation of water flow discharge in natural beds. Water stage and flow. Hydrometric measurements of pressure, stage of water, velocity and discharge of flow. Pipes under pressure, principles and dimensioning. Local losses and losses in length. Dimensioning of siphons and culverts. Determined and undetermined outflow of fluid through orifices. Overflows, classification, calculation principles and application. Critical, supercritical and subcritical motion. Specific energy. Bridges and culverts inside calculation. Swelling curves. Underground water motion.

Literature:

1. Prakash Anand. Water resources engineering: handbook of essential methods and design. ASCE PRESS, 2004
2. Rozgar Baban. Design of diversion weirs. John Wiley & Sons, 1995.
3. Khatsuria R. M., Hydraulics of Spillways and Energy Dissipators. Marcel Dekker, 2005.
4. Chadwick A., Morfett J., Hydraulics in Civil Engineering. E&FN SPON, 1993.

Description of the courses – compulsory courses

2nd semester

CODE CEB3962	**UNDERGROUND STRUCTURES – URBAN INFRASTRUCTURE**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Basic knowledge of soil mechanics and foundation engineering				**Teaching: Traditional**/Distance L.	
Lecturer: Dariusz Łydżba, PhD, DSc, Associate Professor; Cezary Madryas, PhD, DSc, Professor; Adrian Różański, MSc; Marek Kawa, PhD ; Arkadiusz Szot, PhD; Tomasz Abel, MSc ; Andrzej Kolonko, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work/T:	E			T	
ECTS	2			2	
Workload (h)	60			60	

Outcomes: Competences in designing of underground structures. Ability to evaluate loading of shallow and deep tunnels due to rock mass. Knowledge and practical use of rock mass characterization. Familiarity with different execution technologies of deep and shallow excavations.

Content: Introductory information: typical underground structures and urban infrastructures. Longitudinal and transverse profile of tunnel structure. Tunnel protection against fire. Advanced systems of anti-water insulation of underground structures. Loading types of shallow tunnel. Deep tunnels. Rock mass classification. Mining technologies of deep excavation. Shield technology. Execution technology of shallow underground structures. Sewerage objects. Trenchless technologies.

Literature:

1. Hoek E., Support of underground excavations in hard rock, 1995.
2. Megaw T. M., Tunnels: planning, design, construction, 1983.
3. Kolymbas D., Tunneling and tunnel mechanics: a rational approach to tunelling, 2005.
4. Lunardi P., Design and construction of tunnels, 2008.

Description of the courses – compulsory courses

2nd semester

CODE CEB4062	**RAILWAYS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Strength of materials, introduction to soil mechanics				**Teaching: Traditional**/Distance L.	
Lecturer: Marek Krużynski, PhD, DSc, Associate Professor; Jarosław Zwolski, PhD; Igor Gisterek, MSc, Eng.					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work:	T			T	
ECTS	2			2	
Workload (h)	60			60	

Outcomes: The course gives competences in design, construct and maintain railway infrastructure: tracks and stations. It gives understanding of forces flow in the track structure, possible defects and methods of track retrofitting. During the course students get information on building processes, machines and tools applied in railways as well as on obligatory standards and good practices.

Content: Railways history and future. Basic definition of railways. Rail vehicles. Equation of train running. Design of railway track – requirements and good practices. Geometry of railway tracks and clearance. Track structure – rail, sleepers, ballast, rail bonds, subgrade. Examples of track structure and requirements. Railway turnouts and crossings. Railway track on bridges. Continuous welded rail track.

Literature:

1. Bonnet, Practical railway engineering, 2008.
2. Esveld Coenraad, "Modern Railway Track", 2nd ed. Zaltbommel: MRT-Productions, 2001.
3. PN-EN 13803-2. Railway applications – Track – Track alignment design parameters, 2007.

Description of the courses – compulsory courses

2nd semester

CODE CEB4162	**ROADS, STREETS AND AIRPORTS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: fundamentals of roads and streets				**Teaching: Traditional/**Distance L.	
Lecturer: Maciej Kruszyna, PhD; Krzysztof Gasz, PhD; Łukasz Skotnicki, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work/T:	T			T	
ECTS	2			2	
Workload (h)	60			60	

Outcomes: Competence in design within the range of intersections, interchanges, roads' materials and technology, traffic engineering and airports planning.

Content: Roads design. Intersections and interchanges. Pavements, materials and keeping of roads. Streets design. Traffic engineering - fundamentals. Prognoses and modeling of traffic. Capacity of roads and junctions. Control the traffic. Planning of public transport. Calmed traffic. Pedestrian and cyclists traffic. Elements of airports. Numbers, length and directions of airports runways.

Literature:

1. Robinson R., Road Engineering for Development, Taylor & Francis, 2004, ISBN-10: 0415279488.
2. Wells A.T., Young S., Airport Planning and Management, McGraw-Hill Professional, 2004, ISBN-10: 0071413014.
3. Roess R.P., Prassas E.S., McShane W.R., Traffic Engineering (3rd Edition), Prentice Hall, 2004, ISBN-10: 0131424718.

Description of the courses – compulsory courses

2nd semester

CODE CEB4262	**BRIDGES**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Strength of materials. Introduction to structural mechanics. Introduction to soil mechanics and foundation engineering.				**Teaching: Traditional**/Distance L.	
Lecturer: Jan Bień, PhD, DSc, Associate Professor; Maciej Hildebrand, PhD; Jarosław Zwolski, PhD; Tomasz Kamiński, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			30	
Exam / Course work/T:	E			T	
ECTS	2			2	
Workload (h)	60			60	

Outcomes: Competence in design, construction and erection of bridge structures as well as in management of bridge infrastructure.

Content: Course presents fundamental information on bridge structures as important components of transportation infrastructure. Basis of bridge classification, modelling and analysis as well as construction will be introduced and main procedures of bridge design, construction, maintenance and management will be presented. Expected practical results: identification of bridge types and construction systems, application of FEM models in bridge analysis, design of simple bridge structures, identification of damages and selection of testing methods, assessment of bridge condition, application of computer systems in bridge management.

Literature:

1. Lark R., Bridge Design Construction and Maintenance, Thomas Telford, 2007.
2. Mondorf P., Concrete Bridges, Routledge, 2006.
3. Ghosh U. K., Design and Construction of Steel Bridges, Taylor & Francis; 2006.
4. Collings D., Steel Concrete Composite Bridges, Thomas Telford, 2005.
5. Yanew B., Bridge management, Wiley, 2007.
6. Radomski W., Bridge Rehabilitation, World Scientific Publishing Company, 2002.
7. Hendy C. R., Murphy C. J., Designers' Guide to EN 1993-2 Eurocode 3: Design of Steel Structures: Steel Bridges, Thomas Telford, 2007.
8. Hendy C. R., Johnson R. P., Designers' Guide to En 1994-2 Eurocode 4: Design of Steel and Composite Structures: General Rules and Rules for Bridges Taylor & Francis; 2006.

Description of the courses – compulsory courses

2nd semester

CODE CEB5262	CONSTRUCTION TECHNIQUES AND PROCESSES				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits:				**Teaching: Traditional**/Distance L.	
Lecturer: Andrzej Czemplik, PhD; Jarosław Konior, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			30	
Exam / Course work/T:	E			T	
ECTS	2			2	
Workload (h)	45			45	

Outcomes: Familiarization with methods used in basic types of construction works. Basic skills and knowledge needed to managing and supervising construction works.

Content: Earthworks. Concreting. Formworks and scaffoldings. Ground floor construction methods. Erection of structures – methods and machinery. Repair, reinforcing and rebuilding techniques. Demolition of buildings. Technology of pre-casting of structures. Finishing works.

Literature:

1. Concrete construction engineering handbook (ed. Nawy G.) CRC Press, Taylor & Francis Group, 2008.
2. Cooke R., Building in the 21st century. Blackwell Publ., 2007.
3. Delatte N., Concrete pavement design, construction and performance. Taylor & Francis, 2008.
4. Emmitt S., Gorse Ch., Barry's advanced construction of buildings. Blackwell Publ., 2006.
5. Fleming E., Construction Technology an illustrated introduction. Blackwell Publ., 2005.
6. Herzog T., Façade construction manual. Birkhauser, Munich, 2004.
7. Illingworth J. R., Construction methods and planning. Chapman & Hall, 2000.
8. Masonry construction manual. Pfeifer et al. Birkhauser, Munchen, 2001
9. Singh J., Heavy construction: planning, equipment and methods. AA Balkema, 2001.
10. Soffker G., Thrift P., Taylor I., Roof construction manual. Birkhauser, Munich, 2003.

Description of the courses – compulsory courses

2nd semester

CODE CEB4462	**APARTMENT BUILDING**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Principles of building structures, concrete structures				**Teaching: Traditional/**Distance L.	
Lecturer: Andrzej Moczko, PhD;					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30			15	
Exam / Course work/T:	E			T	
ECTS	2			2	
Workload (h)	60			30	

Outcomes: Recent knowledge of the modern building technology related to designing and erecting apartment buildings with a particular attention paid to multi-storey structures. A possibility for students to introduce principles of designing the load bearing walls, assessment of spatial rigidity and structural calculations concerning multi-storey concrete walls weakened by internal openings.

Content: Principles of architectural and structural requirements for designing apartment buildings. Structural characteristic of concrete large slab systems. Loading regimes and principles of structural calculations concerning multi-storey stiffening walls weakened by internal openings. Evaluation of load capacity and spatial rigidity of multi-storey wall structures. Modern building systems based on the monolithic technology. Heat-insulating systems for apartment buildings. Modern thermo- renovation solutions for apartment buildings.

Literature:

1. Petersson H.: Analysis of Loadbearing Walls in Multi-storey Buildings, Chalmers University of Technology, Goeteborg, 1974.

Description of the courses – compulsory courses

2nd semester

CODE CEB5362	**COMPUTATIONAL MECHANICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (I), semester (2)	**Level:** II			**Compulsory**/Optional	
Prerequisits: Theory of elasticity and plasticity				**Teaching: Traditional/**Distance L.	
Lecturer: Kazimierz Myślecki, PhD, DSc, Associate Professor ; Grzegorz Waśniewski, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		30		
Exam / Course work/T:	T		T		
ECTS	1		2		
Workload (h)	30		60		

Outcomes: Technical skills of surface structures FEM modelling. FEM applications to advanced problems of structural mechanics: free vibration of plates, shells and three dimensional beam structures, buckling of plates, shells and three dimensional beam structures, numerical integration of equation of motion, physically nonlinear (plasticity) problems, large displacements FEM equations.

Content: Variational formulation of theory of elasticity: principle of virtual work, Lagrange, Hellinger-Reissner and Hu-Washizu functional. FEM modelling and analysis of surface structures. Compatible and incompatible plate elements. Plane, triangular shell finite element. Nonlinear and dynamics FEM algorithms for shell and 3-D structures: buckling, equilibrium paths, free and forced vibrations. Foundations of BEM analysis on basis of plane problems of elasticity.

Literature:

1. Bathe J-K., Finite Element Procedures, Part 1-2, Prentice Hall 1995.
2. Zienkiewicz O. C., The Finite Element Method for Solid and Structural Mechanics, Butterworth-Heinemann 2005.

Description of the courses – compulsory courses

3rd semester

CODE CEB1263	**CONSTRUCTION PROJECT MANAGEMENT**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			**Compulsory**/Optional	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Andrzej Czemplik, PhD; Jarosław Konior, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	30				
Exam / Course work/T:	T				
ECTS	2				
Workload (h)	60				

Outcomes: Understanding of basic construction management techniques and tools. Managerial skills needed to manage of the construction site

Content: Participants of a construction project and their roles. Site organization schemes. Procurement procedures and tendering. Contracts for construction works. Managing and supervision of design and construction phases. Economy effectiveness of construction projects (NPV, IRR methods). Cost planning and cost control of construction projects. Insurance in construction. Time scheduling techniques and their application in site management. Data bases and internet sources in construction project management. Case studies.

Literature:

1. Clough R.H ., Sears G. A., Construction Project Management. John Wiley 1991
2. Code of Practice: Project Management for construction and development. Blackwell Publ., 2002
3. Ferry D. J., Brandon P. S., Ferry J. D., Cost Planning of Buildings. Blackwelll Science, 1999.
4. Fewings P., Construction project Management – an integrated approach. Taylor & Francis, 2005.
5. Fisk E. R., Construction project administration. Pearson, 2006.
6. Gould F. E., Managing the construction process. Pearson ,2005
7. Harris F., McCaffer, Modern Construction Management. Blackwell Sci. Publ., 1989
8. Johnson R. E., The Economics of Building, John Wiley, 1990
9. Kerzner H., Project Management. Van Nostrand Rein. Comp., 1984
10. Woodward J. F., Construction Project Management – Getting it right first time. Thomas Telford, 1997.

SYLLABUS OF OPTIONAL COURSES

Description of the courses – optional courses

3rd semester

CODE CEB6063	ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits:				**Teaching: Traditional**/Distance L.	
Lecturer: Jan Bień, PhD, DSc, Associate Professor; Jarosław Zwolski, PhD; Tomasz Kamiński, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		T		
ECTS	1		1		
Workload (h)	30		30		

Outcomes: Acquisition of knowledge and representation in computer systems by means of artificial neural networks, fuzzy reasoning and hybrid networks as well as design of simple expert systems and their application in civil engineering.

Content: Introduction to artificial intelligence and knowledge acquisition and representation in computer systems. Basis of design of knowledge-based expert systems supporting decision processes in civil engineering. Expert systems architecture, data base and knowledge base. Artificial neural network technology – architecture, training, applications. Fuzzy logic and fuzzy reasoning in civil engineering. Hybrid networks technology – components, architecture, applications. Testing and validation of expert systems with elements of artificial intelligence.

Literature:

1. Russell S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall, 2009.
2. Samarasinghe S., Neural Networks for Applied Sciences and Engineering: From Fundamentals to Complex Pattern Recognition, Auerbach Publications – Taylor & Francis Group, 2006.
3. Wang P. P., Ruan D., Kerre E. E., Fuzzy Logic: A Spectrum of Theoretical and Practical Issues, Springer, 2007.

Description of the courses – optional courses

3rd semester

CODE CEB6163	**MODERN TESTING METHODS FOR NONDESTRUCTIVE INSPECTION OF BUILDING STRUCTURES**				
Language: English			**Course:** Basic/**Advanced**		
Year (I), semester (3)	**Level:** II		Compulsory**/Optional**		
Prerequisits:			**Teaching: Traditional/**Distance L.		
Lecturer: Andrzej Moczko, PhD; Zygmunt Matkowski, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		T		
ECTS	1		1		
Workload (h)	30		30		

Outcomes: Acquisition of knowledge of the advanced non-destructive testing methods and possibilities of their practical applications. A possibility for students to introduce several modern NDT systems. In particular, recommendations for using such techniques for technical inspection of building structures are discussed.

Content: Recent knowledge of the advanced non-destructive testing methods.

Literature:

1. Schickert G., Wiggenhauser H., Non-Destructive Testing in Civil Engineering. Berlin 1995.
2. Bungey J.H., Millard S.G., Testing of Concrete in Structures, Chapman & Hall, 1996.

Description of the courses – optional courses

3rd semester

CODE CEB 6263	**BUILDING PHYSICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits: Building physic - basic course				**Teaching: Traditional/**Distance L.	
Lecturer: Henryk Nowak, PhD, DSc, Associate Professor; Elżbieta Śliwińska, PhD; Maja Staniec-Birus, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		T		
ECTS	1		1		
Workload (h)	30		30		

Outcomes: Competence in design and maintenance of low-energy buildings but also in renewable energy use in multi-storey and public buildings.

Content: Course is presenting fundamental information regarding with the advanced problems of steady – state and transient heat transfer through the building envelope and its thermal dynamic properties. The principles of designing of building envelope in the range of heat and mass transfer for different buildings. Heat transfer through the windows and glazed facades with different type of glazing, calculation methods, technical possibilities of realization, visual comfort. A new technologies applied at buildings thermomodernization, and in low-energy buildings. Ecological aspects of energy-saving in buildings. Low-energy buildings: criteria of assessment, classification, the rules of designing and realization. The use of renewable energy in different kind of buildings to improve their energy balance. The earth-sheltered buildings: classification, typical details, heat transfer through the ground, heat transfer of building in contact with a ground, energy conservation problems.

Literature:

1. Beggs C., Energy Management, Supply and Conservation. Elsevier, 2002.
2. Clark J., Energy Simulation in Building Design. Wiley Company, 2001.
3. Gratia E., DeHerde A.: Passive Solar Architecture. BRE, 2006.
4. Hens H., Buildings Physics – Heat, Air and Moisture. Ernst & Sohn, 2007.
5. Moss K., Heat and Mass Transfer in Buildings. Elsevier, 2007.
6. Twidell J., Weir T., Renewable Energy Resources. Taylor & Francis, 2006.

Description of the courses – optional courses

3rd semester

CODE CEB6363	**HYDROLOGY FOR ENGINEERS**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisites: Basic knowledge of geodesy, statistics and hydraulics				**Teaching: Traditional/**Distance L.	
Lecturer: Wojciech Rędowicz, PhD; Jerzy Machajski, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		T		
ECTS	1		1		
Workload (h)	30		30		

Outcomes: Competence in observations of the hydrology phenomena, analysis of measurement data giving reliable information for engineering practice. Determination methods for fundamental hydrologic characteristics which constitutes the basic material for planning, designing and building hydrologic structures. Fundamentals for mathematic modeling of hydrological systems.

Content: Problems and tasks of hydrology for engineers. Characteristic water levels. Hydrographic curves. Correlation and regression calculus in hydrology. Flow rate curve. Probability of hydrologic phenomena. Determination of probable maximum and minimum flows. Transfer methods of hydrological information. Indirect methods of obtaining hydrological information. Hydrologic measurement. Determination of maximum flows for small drainage basins. Fundamentals of mathematical modelling of hydrological phenomena. Examples of applied hydrological mathematical models.

Literature:

1. Baban R., Design of diversion weirs. John Wiley & Sons , 1995.
2. Chow V. T., Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.
3. Chow V. T., Mays L.W., Maidment D. R. ,Applied Hydrology, McGraw-Hill, New York, 1988.
4. Ghosh S. N., Flood control and drainage engineering, A.A. Balkema/Rotterdam/Brookfield, 1999.
5. Khatsuria R. M., Hydraulics of Spillways and Energy Dissipators. Marcel Dekker, 2005.
6. Prakash A., Water resources engineering: handbook of essential methods and design. ASCE PRESS, 2004.

Description of the courses – optional courses

3rd semester

CODE CEB6463	**DYNAMICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits: Strength of materials. Introduction to dynamics. Structural mechanics				**Teaching: Traditional/**Distance L.	
Lecturer: Zbigniew Wójcicki, PhD, DSc, Associate Professor; Jacek Grosel, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		T		
ECTS	1		1		
Workload (h)	30		30		

Outcomes: Competence in structure elements calculations, dynamic load and resonance occurrence prediction. Application of principles of dynamics to the analysis of the motion of systems consisting of material points and stiff solids.

Content: Principle of dynamic (Newton's law of motion, D'Alembert's principle), degrees of freedom, springs in parallel or in series, solution of the differential equation of motion, amplitude of motion, undamped single degree-of-freedom systems (SDOF), damped single degree-of-freedom systems (viscous damping, equation of motion, critically damped system, overdamped system underdamped system, logarithmic decrement), response of SDOF system to harmonic load undamped and damped systems. kinematically forced vibrations. Inertia excited vibrations. Multi-degree-of-freedom MDOF systems eigenproblem (eigenvalues and eigenvectors). Eigenproblem (eigenvalues and eigenvectors). Natural frequencies and normal modes, orthogonality property of the normal modes, reductions of dynamic mtrices, satic and dynamic condensation.

Literature:

www.iil.pwr.wroc.pl/wojcicki

1. Paz M., Leigt W., Structural Dynamics. Theory and Computation, 5th edition, Springer, 2004.

Description of the courses – optional courses

3rd semester

CODE CEB6563	PRESTRESSED CONCRETE STRUCTURES				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits: Completed course of concrete structures				**Teaching: Traditional/**Distance L.	
Lecturer: Roman Wróblewski, PhD; Janusz Pędziwiatr, PhD; Marek Maj, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			15	
Exam / Course work/T:	T			T	
ECTS	1			1	
Workload (h)	30			60	

Outcomes: Understanding of design of elements under bending and tension, but also axis-symmetric pre-stressed structures. Preparation of provisions for manufacturing and assembling of pre-tensioned and post-tensioned elements. Gain information on new generation concrete technology, properties of high strength steel and pre-stressing equipment. Competences of a designer and supervising inspector.

Content: Idea of pre-stressing of concrete structures. Specific properties of concrete and steel. Method of manufacturing of beam and thin walled pre- and post-tensioned structures. Design methodology. Case studies. Durability, repair and strengthening of pre-stressed structures.

Literature:

1. Raju N. K., Pre-stressed concrete, 2008.
2. Fogarasi Gyula, Pre-stressed concrete technology, 1986.
3. Navy E. G.: Pre-stressed Concrete. A Fundamental Approach. Prentice Hall, Upper Saddle River, New Jersey 07458, 2000.
4. Teng S., Kong F. K.: Reinforced and Prestressed Concrete: Eurocodes Taylor & Francis Ltd; 2009.
5. Hurst M. K.: Prestressed Concrete Design Taylor & Francis, 1998.
6. EN 1992-1-1: Eurocode 2: Design of concrete structures-Part 1-1: General rules and rules for buildings.
7. EN 1992-3: Eurocode 2: Design of concrete structures-Part 3: Liquid retaining and containing structures.

Description of the courses – optional courses

3rd semester

CODE CEB6663	**TIMBER STRUCTURES**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Prof. Jerzy Jasieńko, PhD, DSc; Tomasz Nowak, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			15	
Exam / Course work/T:	T			T	
ECTS	1			1	
Workload (h)	30			60	

Outcomes: Acquiring knowledge on designing, fabrication and assembly of solid and glued timber structures.

Content: The course comprises a compendium of knowledge on designing technically advanced solid and glued timber structures taking into account properties of relevant wood and methods of protection along with recommendation on specifics of conservation and reinforcement process of historical timber structures.

Literature:

1. Breyer D., Design of wood structure – ASD/LRFD, 2007.
2. Richarson B. A., Wood in construction, 1976.

Description of the courses – optional courses

3rd semester

CODE CEB6763	**CONSERVATION AND STRENGTHENING OF MONUMENTAL HERITAGE STRUCTURES**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Prof. Jerzy Jasieńko, PhD, DSc; Tomasz Nowak, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			15	
Exam / Course work/T:	T			T	
ECTS	1			1	
Workload (h)	30			60	

Outcomes: Acquiring know-how in the scope of conservation and strengthening of historical building and architectural objects.

Content: The course consists in imparting know-how associated with the specifics of approach, conservation and strengthening, acceptable from point of view of conservator's doctrine of historical timber, brickwork and stone masonry structures.

Literature:

1. Lourenco P. B., Melo A., Carneiro M., "Remedial measures for the Cathedral of Porto: a post-modern conservation approach" Proceeding of the IV Int. Sem. on Structural Analysis of Historical Constructions, Padwa, Italy, 2004. A. A. Balkema Publishers.
2. Yeomans D., "The repair of historic timber structures", Thomas Telford, London 2003.
3. Hendry A., "Structural masonry". MacMillan, London, 1998.
4. ART Conference materials: "Non-destructive testing and microanalysis for the diagnostics and conservation of the cultural and environmental heritage", Budapest 1996, Rome 1999.
5. Conference materials: "Structural analysis of historical construction", Padwa 2004, New Delhi 2006.

Description of the courses – optional courses

3rd semester

CODE CEB6863	**EFFECTIVE PROPERTIES OF COMPOSITES - INTRODUCTION TO MICRO-MECHANICS**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisits:				**Teaching: Traditional/**Distance L.	
Lecturer: Dariusz Łydżba, PhD, DSc, Associate Professor; Adrian Różański, MSc					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			15	
Exam / Course work/T:	T			T	
ECTS	1			1	
Workload (h)	30			60	

Outcomes: Knowledge and practical use of estimation methods of effective properties of linear random composites. Knowledge of basic microstructure descriptors. Ability to valuing of microstructure effect on effective properties of composites.

Content: The course is devoted to mathematical modeling of the processes taking place in micro-structured media. Special focus would be paid on micro-mechanics method for random composites as well as that with periodic microstructure.. The microstructure descriptors based on n-point probability measure will be presented. The estimation methods of effective properties of composites will be discussed in details, i.e. Mori-Tanaka method, Maxwell approximation scheme as well as the self-consistent method. The effective transport and mechanical properties of composite materials will be investigated by estimation methods as well as numerical determination based on the unit cell boundary value problem. The approaches presented will be illustrated by the solutions of appropriate chosen simple problems, i.e. determination of diffusion effective properties of inclusion-matrix random composites as well as for periodic laminates. Some technique of mathematical microstructure reconstruction based on Simulated Annealing method will end the course.

Literature:

1. Miltom G. W., The Theory of Composites. Cambridge University Press 2002.
2. Torquato S.., Random Heterogeneous Materials, Springer 2000.
3. Hornung U., Homogenization and porous media, Springer 1997.
4. Cherkaev A., Variational methods for structural optimization, Springer 2000.

Description of the courses – optional courses

3rd semester

CODE CEB6963	**METHODS OF APPLIED STATISTICS (GEOSTATISTICS)**				
Language: English				**Course:** Basic/**Advanced**	
Year (II), semester (3)	**Level:** II			Compulsory/**Optional**	
Prerequisites: Basic knowledge of mathematical statistics and informatics				**Teaching: Traditional/**Distance L.	
Lecturer: Barbara Namysłowska-Wilczyńska, PhD, DSc, Professor; Ewa Koszela-Marek, PhD					
	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15			15	
Exam / Course work/T:	T			T	
ECTS	1			1	
Workload (h)	30			60	

Outcome: Ability to conduct a multidimensional structural analysis of variability of the studied phenomena, estimation and interpolation of variables on regular grid and the simulation of values in geostatistics.

Content: Subject-matter of the course will be the geostatistical methods – a special branch of applied statistics, short outline of theory and examples of application of geostatistics. Such functions as variogram, covariance and autocorrelation, estimation techniques: ordinary, simple kriging and cokriging (in modification: block and point kriging) representing a linear, stationary geostatistics and - indicator variogram and indicator kriging and then simulation (non-conditional and conditional simulation) making a non-linear, non-stationary geostatistics will be presented. These methods have been used for the processing, analyzing and forecasting of Z^* average values and simulating of Z_s values of the studied parameters with minimum estimation and simulation variance, using data (1-, 2-, 3- dimensional) contained in the elaborated thematic data bases. Various examples of application of proposed research methodology connected with geostatistical methods to the solving of problems of the average estimated values Z^* evaluating and Z_s simulating of the analyzed parameters and as well as for the filtering of variation random component (variable response to the noise), in technical sciences (geotechnics, mining, geodesy, power system engineering,), in Earth Sciences (engineering geology, hydrogeology) and in environmental sciences, will be demonstrated. Geostatistical methods make possible the conducting a multidimensional structural analysis of variability of the studied phenomena, estimation and interpolation of variables on regular grid and the simulation of values too. Moreover these techniques permit to obtain the raster maps and block diagrams of probability of exceeding of a given threshold values for the analyzed variables.

Literature:

1. Armstrong M., Basic Linear Geostatistics. Berlin: Springer, 1998.
2. Chauvet P., Processing Data with a Spatial Support: Geostatistics and its Methods. Cahiers de Geostatis tique 4. Paris: ENSMP, 1993.
3. Chiles J. P., Delfiner P., Geostatistics: Modeling Spatial Uncertainity. N. Y.: Wiley, (Wiley series in probability and statistics), 1999.
4. Isaaks E., Srivastava R.Mohan, Introduction to Applied Geostatistics. New York Oxford, Oxford Univer sity Press, 1989.
5. Lantuejoul C., Geostatistical Simulation, Models and Algorithms. Berlin: Springer, 2002.
6. Rivoirard J., Introduction to Disjunctive Kriging and Non-linear Geostatistics. Oxford: Clarendon, 1994.
7. Wackernagel H., Multivariate Geostatistics, An Introduction with Applications. 2 nd edition, Springer – Verlag Berlin Heidelberg New York, 1998.