Structural Engineering MSc Curricula

Contain

Course descriptions

General Studies in Engineering

Credits: 4

Advanced Mathematics

Weekly Hours: 2 lectures, 2 practical lessons, 0 lab.
Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: Basic concepts and rules of probability: random experiments, sample space, events, counting, probability of events, conditional probability, independence of events, total probability rule, Bayes-rule. Discrete random variables: probability mass function and cumulative distribution function, mean and variance. Discrete distributions: uniform, Bernoulli, binomial, geometric, hypergeometric and Poisson. Continuous random variables: density function and cumulative distribution function, mean and variance. Continuous distributions: uniform, normal, exponential, gamma, t and chi-square. Joint probability distributions. Random sampling and data description. Point estimation of parameters. Confidence interval for a single sample. Test hypothesis for a single sample. Linear regression and correlation. The Maple computer algebra system is used for solving random problems and statistical computations.

Recommend Readings:

1. *Sheldon M. Ross*: Introduction to Probability and Statistics for Engineers and Scientists, Fourth Edition, Academic Press, 2009.
2. Readings are found on platform of CooSpace https://coospace.tr.pte.hu/
3. M.H. Debroot, M.J.Schervish: Probability and Statistics (2011)

Responsible of Subject: Dr. Klincsik Mihály, associate professor, CSc

Credits: 3

Numerical Methods

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 1.

Prerequisites: -

Course Description

The course is an introduction to the basics of numerical methods which are indispensable in further studies of structural engineering subjects, e.g. structural analysis and structural optimization. This course not provides the full aspects of the theory and application of numerical methods, but represents the subject in engineering point of view where some benchmark problem is presented and solved using commercial software.

Purpose and Target Audience

This course is offered for MSc students who are interested in the multidisciplinary design aspects of complex systems. These aspects appear frequently during the conceptual and preliminary design phases of complex new systems and products, where technical disciplines (structures, propulsion, aerodynamics, controls, optics etc…) and non-technical disciplines (lifecycle costing, manufacturing, environmental impact analysis, marketing, etc…) have to be tightly coupled in order to arrive at a competitive solution. During the product development process (PDP) both quantitative and qualitative effort streams are present, where qualitative work gives rise to quantitative questions and vice-versa. This course is mainly focused on the quantitative aspects of design and presents a unifying framework called "Multidisciplinary System Design Optimization" (MSDO). We will always attempt to show the strengths of MSDO, but also its limitations in the greater qualitative context of design. A simple way to say this is: "Conceptual design and system architecting define the design vector, quantitative, computational design attempts to populate this vector with values that will lead to a good product or system". The objective of the course is to present tools and methodologies for performing system optimization in a multidisciplinary design context.

Recommend Readings:

1. *Uri Kirsch*: Structural Optimization: Fundamentals And Applications, ISBN 978-3-642-84845-2
2. *Uri Kirsch*: Optimum Structural Design Publisher: McGraw-Hill Inc.,US (March 1, 1981) Language: English, ISBN-10: 0070348448, ISBN-13: 978-0070348448
3. *Moin, P.,* 2001, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, New York, ISBN-13: 9780521711234
4. *Hoffman, J.D.*, 2001, Numerical Methods for Engineers and Scientists - Second Edition, Marcel Dekker, Inc., New York, ISBN-13: 978-0824704438, ISBN-10: 0824704436

Responsible of Subject: Professor Dr. Csébfalvi Anikó, CSc

Credits: 2

Database Systems

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: This course provides the students with an introduction to the core concepts in databases. It is centered around the core skills of identifying organizational information requirements, modeling them using conceptual data modelling techniques, converting the conceptual data models into relational data models and verifying its structural characteristics with normalization techniques, and implementing and utilizing a relational database using an industrial-strength database management system.

The subject includes database building practice in MSACCESS, and creating forms and reports.

Recommend Readings:

1. *Elmasri and Navathe,* Fundamentals of Database Systems, 6th Edition, Addison-Wesley, 2010. ISBN-13: 9780136086208
2. *Jeffry D.* Ullmann, Jennifer Widom, First course in Database systems, 3th edition, Prentice Hall, 2007, ISBN-13: 9780136006374
3. *Jim Melton and Alan R. Simon.* SQL 1999: Understanding Relational Language Components. First Edition, 1999.Morgan Kaufmann Publishers.ISBN: 1-55860-456-1
4. *Don Chamberlin.* Using the New DB2: IBM's Object-Relational Database System. First Edition, 1996.Morgan Kaufmann Publishers.ISBN: 1-55860-373-5

Responsible of Subject:: Dr. Szendrői Etelka, associate professor, PhD

Credits: 5

Advanced Mechanics

Weekly Hours: 2 lectures, 2 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: This course is aimed to provide basic and advanced knowledge on the principles of the continuum mechanics and equations of kinematics. Topics covered by the course include: Definition of strain, theory of small and large strains, strain tensors, definition of stress, stress tensors, stress and strain pairs, definitions of elastic, plastic and elasto-plastic material models, basic equations of continuum mechanics, work and energy theorems, displacement and force methods, stress functions, basic equations of beams, plates and shells. The course also includes applications and examples for all theorems.

Recommend Readings:

1. *L. S. Srinath*, Advanced Mechanics of Solids, 2 nd ed., Tata McGraw Hill, 2003. ISBN 13: 978-0-07-13988-6 ISBN 10: 0-07-13988-1
2. *S. P. Timoshenko, J. N. Goodier*, Theory of Elasticity, 3 rd ed., McGraw Hill, 1970. ISBN 0-07-07-2541-1
3. *A. P. Boresi, R. J. Schmidt*, Advanced Mechanics of Materials, 6 th ed., Wiley, 2003. ISBN: 978-0-471-43881-6

Responsible of Subject: Dr. Pomezanski Vanda, assistant professor, PhD

Credits: 2

Building Physics and Chemistry

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: Unifying character overview, summary and update of the Buildings' Physics knowledge acquired during the BSc course in accordance with the changes in legislation occurred since the BSc course. Followed the summary and update the following subjects are discussed: multi-dimensional heat transfer and temperature distribution, cold-bridges, up-to-date ventilation systems, thermal comfort measures, glazing and shading devices, low energy buildings, passive solar techniques, passivhaus. Acoustics: acoustical properties of vertical and horizontal structures from the point of view of sound insulation and seismic inhibition. Unifying character overview, summary and update of the Buildings' Chemistry knowledge acquired during the BSc course. Recent developments in Buildings' Chemistry including nano technology.

Recommend Readings:

1. *Gudni A. Jóhannesson*, Building Physics, TERC Kft. • Budapest, 2013,
2. *Victor and Aladar Olgyay*: Solar Control and Shading Devices – February 21, 1977 nd Bioclimatic Approach to Architecture, Design with Climate: Bioclimatic Approach to Architectural Regionalism, 1963, ISBN-10: 0691023581; ISBN-13: 978-0691023588
3. *Carl-Eric Hagentoft* Introduction to Building Physics – January 1, 2001, ISBN-13: 978-9144018966 ISBN-10
4. Chemsistry in Context by Cram101 textbook Reviews

Responsible of Subject: Dr. Fülöp László, associate professor, PhD

Credits: 2

Mathematical Modelling of FEM

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: This course is aimed to provide basic and advanced knowledge on the Finite Element Modelling. Topics covered by the course include: Theoretical ground and application of Galerkin and Ritz methods, basic steps of the general finite element analysis, geometrical and mathematical finalization, calculation of elementary stiffness matrices, compilation technics, estimation of numerical errors, locking problems, the question of stability and convergence.

Recommend Readings:

1. *Bathe, K.-J.,* Finite Element Procedures, Prentice Hall, ISBN-10: 097900490X; ISBN-13: 978-0979004902
2. *Belytschko, T., Liu, W. K., and Moran, B..,* Nonlinear Finite Elements for Continua and Structures, Wiley, ISBN-13: 978-0471987741 ISBN-10: 0471987743
3. *MADENCI, E. -- GUVEN, I.* The Finite Element Method and Applications in Engineering Using ANSYS. University of Arizona: Springer, 2006. 689 p. ISBN 0-387-28289-0

Responsible of Subject: Dr. Pomezanski Vanda, assistant professor, PhD

Professional Studies in Structural Engineering

Credits: 2

Theoretical Basis of Structural Design

Weekly Hours: 1 lecture, 1 practice, 0 lab.

Language of Instructions: English

Grading: Semeser Mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: Structural materials, structural effects, definitions of structural shapes. Structural design. Structural costs, damage ratio, safety, reliability. Optimized risk. Deterministic and probabilistic methods of design. Eurocode program. Ultimate and serviceability limit states. Conception of limit states. Design, characteristic and representative values. Partial factors. Design supported by experiments. Effects on structures. Combinations of effects in design states.

Recommend Readings:

1. *R. Park and T. Pauley*, Reinforced concrete structures, John Wiley and sons, ISBN-13: 978-0471659174 ISBN-10: 0471659177
2. *A. K. Jain*, Reinforced Concrete: Limit State Design, NemChand and Bros. 1999. ISBN-13, 9788185240794
3. *J. Krishna and OP Jain*, Plain and Reinforced Concrete, Vol. I I, Roorkee, Nem Chand and Bros., ISBN 9788185240091
4. *H. Nilson, D. Darwin and C. W. Dolar*, Design of Concrete Structures, Tata McGraw Hill, ISBN-13: 978-0073293493 ISBN-10: 0073293490

Responsible of Subject: Dr. Fülöp Attila, assistant professor, PhD

Credits: 4

Advenced Structural Analysis

Weekly Hours: 2 lectures, 2 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 1.

Prerequisites: -

Course Description

The course covers the matrix methods of structurally determinate and indeterminate trusses, frame structures, and cable supported structures, including the basics matrix theory and determination of mathematical modelling of structures. This course uses computer-based methods for the analysis of large-scale structural systems. Topics covered include: modelling strategies for complex structures; application to tall buildings, cable-stayed bridges, and tension structures; introduction to the theory of active structural control; design of classical feedback control systems for civil structures; and simulation studies using customized computer software.

Purpose and Target Audience

This course is offered for MSc students who are interested in the multidisciplinary design aspects of complex systems. These aspects appear frequently during the conceptual and preliminary design phases of complex new systems and products, where technical disciplines (structures, propulsion, aerodynamics, controls, optics etc…) and non-technical disciplines (lifecycle costing, manufacturing, environmental impact analysis, marketing, etc…) have to be tightly coupled in order to arrive at a competitive solution. During the product development process (PDP) both quantitative and qualitative effort streams are present, where qualitative work gives rise to quantitative questions and vice-versa. This course is mainly focused on the quantitative aspects of design and presents a unifying framework called "Multidisciplinary System Design Optimization" (MSDO). We will always attempt to show the strengths of MSDO, but also its limitations in the greater qualitative context of design. A simple way to say this is: "Conceptual design and system architecting define the design vector, quantitative, computational design attempts to populate this vector with values that will lead to a good product or system". The objective of the course is to present tools and methodologies for performing system optimization in a multidisciplinary design context.

Recommend Readings:

1. *Connor, Jerome J.* Introduction to Structural Motion Control. Prentice Hall, 2002. ISBN: 0130091383
2. *Connor, Jerome J.* Analysis of Structural Member Systems. Ronald Press, 1976
3. *Coates, Coutie and Kong*: Structural Analysis; ISBN-13: 978-0278000353 ISBN-10: 0278000355

Responsible of Subject: Professor Dr. Csébfalvi Anikó, CSc

Credits: 2

Advenced Structural Dynamics

Weekly Hours: 1 lecture, 1 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: Dynamic effort of impulse loads for single degree of freedom systems in elastic and plastic states. Calculations of natural frequencies and mode shapes for beams. Free vibration of beams. Excitation of beams by moving force. Exact dynamic stiffness matrices of beam systems. Dynamic stiffness matrices in case of application of finite element method. Calculation of vibration equations using modal analysis and numerical integrations. Calculation of machine foundations. Dynamic calculation of structure in case of support movements. Earthquake response analysis for SDOF. Dynamic effects of wind loads. Equations of motion for multi degree of freedom structures.

Recommend Readings:

1. *Kolousek:* Dinamics in Engineering, Published by Newnes-Butterworth (1973), ISBN 10: 0408701609, ISBN 13: 9780408701600
2. Institution of Structural Engineers/AFPS. Manual for the design of steel and concrete buildings to Eurocode 8. October 2010.
3. *Fardis M et al.*- Designers' guide to EN1998 (Pts 1 & 5). Thomas Telford, London, 2005. ISBN: 0727733486
4. *Fardis, Michael N* - Seismic design, assessment and retrofitting of concrete buildings- based on EN-Eurocode 8. Springer 2009. ISBN 978-1-4020-9842-0
5. *Elghazouli A.* (editor) - Design of Buildings to EC8. Taylor and Francis, 2009. ISBN 9780415447621

Responsible of Subject: Dr Orbán Ferenc, associate professor, PhD

Credits: 2

Interaction between Soil and Structures

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: This course aims at teaching the basics of soil mechanics connecting to the (geotechnical) structures and covers the following topics: basics of Euro code 7, equilibrium states and conditions of equilibrium; deep excavation; anchoring; monitoring systems.

This subject intends to provide students with knowledge in the basics of geotechnical serviceability and ultimate limit state, excavation methods, and lateral supporting systems (e.g. braced excavation, top-down,- anchored method), retaining walls, strutting systems. An additional objective is to prepare students with a basic knowledge for compare monitoring,- and calculated results.

Recommend Readings:

1. *Bond, A. and Harris* A.: Decoding Eurocode 7, London: Taylor & Francis 2008. ISBN: 9780415409483
2. *Chang Y.O.:* Deep Excavation, Theory and Practice, London: Taylor & Francis 2006. ISBN 9780415403306
3. *P. Raj,* Geotechnical Engineering, Tata McGraw Hill, ISBN: 9054101288

Responsible of Subject: Dr. Szűcs István, associate professor, CSc

Credits: 2

Advanced Architectural Design

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: Study of the design and construction of commercial building projects. Introduction and built in practice to current (architectural) engineering design issues. Course focuses on big-scale industrial buildings with concrete, load-bearing or steel primer structures with its need relevant secondary structures as roof, façade or more surfaces. The course includes an introduction to many of the varied factors involved in building design and construction, including fundamentals of location, site design, approach, utility connections and other services, pavement, greenery, energy efficiency, natural lightening and ventilation, acoustics and fire protection and control, investigates the interrelationship between design decisions and scheduling, network scheduling, cost loading and cost control in construction on project.

Recommend Readings:

1. *Ching, Onouye, Zuberbuhler*. 'Building Structures Illustrated'. Published by John Wiley and Sons, Inc. ISBN 978-0-470-18785-2.
2. *Jimmie Hinze*, Construction Planning & Scheduling, 4th ed., Pearson/Prentice Hall, Upper Saddle River, NJ, 2012.
3. *Neufert, Ernst* - Architects' data. Edition, illustrated. Publisher, Archon Books, 1970. Original from, the University of Michigan. ISBN: 978-1-4051-9253-8.

Responsible of Subject: Dr Hutter Ákos, associate professor, DLA

Credits: 3

Theory of Structural Stability

Weekly Hours: 2lectures, 1practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: Introduction to the theory of structural stability. The possible ways of reaching load bearing capacity, definition of static loading, methods of producing structural static models. Mathematical backgrounds of stability design (static method /eigenvalue problem/, energy method /variational problem/, kinematic method). Planar and 3D buckling problems of general bars, frames and trusses. Investigation of the local plate buckling of plates and plated structures (linear and non-linear); analysis of the post-critical (post-buckling) behavior and the post-critical load-bearing capacity.

Recommend Readings:

1. *Iványi, M. - Skaloud, M.*: Steel Plated Structures, CISM Courses and Lectures No 358, International Centre for Mechanical Sciences, SPRINGER - Verlag, Wien - New York, 1995, p. 373. ISBN: 3-211-82742-0
2. *S. P. Timoshenko, J. N. Goodier*, Theory of Elasticity, 3 rd ed., McGraw Hill, 1970. ISBN 0-07-07-2541-1
3. *Chajes, A.*: Principles of structural stability theory, Prentice-Hall, 1974, ISBN 978 013 7099 64 1

Responsible of Subject: Dr. Fülöp Attila, assistant professor, PhD

Credits: 4

Geotechnical Design

Weekly Hours: 2 lectures, 1 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: This course aims at teaching the basics of geotechnical design and covers the following topics: Basis of structural design, General rules for geotechnical design, Ground investigation and testing, Ground characterization, Design of footings and piles.
This subject intends to provide students with knowledge in the basics of actions and materials, depth of investigation points, identification and classification of soil and rock, sampling, groundwater measurements, laboratory and in-situ tests, derive geotechnical parameters. An additional objective is to prepare students with a basic knowledge for planning piles using cone penetration test.

Recommend Readings:

1. *Bond, A. and Harris* A.: Decoding Eurocode 7, London: Taylor & Francis 2008. ISBN: 9780415409483
2. P. Raj, Geotechnical Engineering, Tata McGraw Hill, ISBN: 9054101288
3. *R F Craig*, Soil Mechanics, Chapman and Hall (ELBS), ISBN: 0415561256

Responsible of Subject: Dr. Szűcs István, associate professor, CSc

Credits: 2

Building Materials

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: The course provides advanced knowledge in the field of building materials and technologies. The subjects covered include: novel insulation materials and systems, PUR fumes with simultaneous heat and water insulation capability, corkwood products and coatings, novel water insulation products and technologies, novel plywood structures, concrete surfaces with high aesthetic requirements, novel concrete design procedures, high strength and high performance concrete, durable concrete, self-compacting concrete, foam concrete, fibre reinforced concrete, novel concrete testing methods, novel formwork systems, industrial floors, application of nano-technology.

Recommend Readings:

1. *Mamlouk, Zaniewski*, "Materials for Civil and Construction Engineers". Addison Wesley, ISBN-10: 0-13-611058-4
2. *Simmons, Olin,* "Construction – Principles, Materials and Methods". J. Wiley & Sons – Ramsey, ISBN: 978-0-470-54740-3
3. *Onouye, Kane*, "Statics and Strength of Materials for Architecture and Building Construction". Pearson Education, Prentice Hall, ISBN-13: 978-0135079256ISBN-10: 013507925X

Responsible of Subject: Dr Orbán Zoltán, assistant professor, PhD

Credits: 3

Strengthening of Structures

Weekly Hours: 2lectures, 0 practice, 0 labor

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 1.

Prerequisites: -

Brief Syllabus: This course is aimed to provide basic and advanced knowledge on the principles of the rehabilitation and strengthening of structures constructed from various types of materials. Topics covered by the course include: deterioration of structural materials, inspection, diagnosis and assessment of structures, basic principles of structural rehabilitation and strengthening, methods of strengthening steel, concrete and timber structures, introduction of specific technologies such as strengthening with shot Crete, strengthening and repair with high performance concrete (HPC), strengthening with fibre reinforced plastics (FRP), design examples and case studies on strengthening bridges, buildings and other civil engineering structures.

Recommend Readings:

1. *Owens .G.W. & Knowels. P*. "Steel Designers Manual", (sixth Editi Steel Concrete Institute (UK) Oxford Black; well Scientific Publications, 2003, ISBN: 978-1-4051-3412-5
2. *Johnson.R.P.* "Composite Structures of Steel and Concrete". Vol-I, # Oxford Black; well Scientific Publications (Third Edition) U.K. 2004, ISBN: 978-1-4051-0035-9
3. *Bungale S. Taranath,* "Structural Analysis and Design of Tall Buildings", CRC Press, CRC Press, 2010., ISBN-13: 978-0070629141 ISBN-10: 0070629145

Responsible of Subject: Dr. Orbán Zoltán, assistant professor, PhD

Credits: 4

Surface Structures

Weekly Hours: 2 lectures, 1 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: **2**

Prerequisites: *Advanced Structural Analysis*

Brief Syllabus: This course is aimed to provide basic and advanced knowledge on the principles of the surface structures, forms, loads, displacements and stress fields. Topics covered by the course include: special problems of model creation, homogenization, anisotropy nonlinearity, the difference between a bended plate and plate in plane stress, general solutions, plates with large displacements, reinforced concrete slabs, 3D plate systems, shell structures, membrane forces, boundaries, boundary problems, bending theory of shell structures, stability problems.

Recommend Readings:

1. *M. Lal Gambhir*, "Stability Analysis and Design of Structures," Springer, 1st edition 2004. , ISBN 978-3-662-09996-4
2. *Z. Bazant and L. Cedolin*, "Stability of Structures," Oxford University Press, Inc., 1991, ISBN-13: 978-0-471-98716-1, ISBN: 0-471-98716-6
3. *Luis A. Godoy*, "Theory of Elastic Stability: Analysis and Sensitivity," Taylor & Francis Group, 2000.
4. *W. Xie,* "Dynamic Stability of Structures," Cambridge University Press, 2006., ISBN-13: 978-1560328575 ISBN-10: 1560328576

Responsible of Subject: Dr. Pomezanski Vanda, assistant professor, PhD

Credits: 4

Structural Optimization

Weekly Hours: 2 lectures, 1 practice, 0 lab.

Language of Instructions: English

Grading: Exam

Place of Subject in Curriculum: **2**

Prerequisites: *Numerical Methods, Advanced Structural Analysis*

Course Description

The course covers the optimal design of structurally determinate and indeterminate truss and frame structures, including the determination of mathematical modeling of structural optimization, goal functions and structural constraints. After the introduction to the convex programing problems, the basics of local and global optimum are defined. The Lagrangian problem is presented using the Kuhn-Tucker conditions. Benchmark problems are solved in order to demonstrate the structural implementations. Linear and nonlinear programing methods are introduced and extended to the structural optimization problems based on energy methods.

Purpose and Target Audience

This course is offered for MSc students who are interested in the multidisciplinary design aspects of complex systems. These aspects appear frequently during the conceptual and preliminary design phases of complex new systems and products, where technical disciplines (structures, propulsion, aerodynamics, controls, optics etc…) and non-technical disciplines (lifecycle costing, manufacturing, environmental impact analysis, marketing, etc…) have to be tightly coupled in order to arrive at a competitive solution. During the product development process (PDP) both quantitative and qualitative effort streams are present, where qualitative work gives rise to quantitative questions and vice-versa. This course is mainly focused on the quantitative aspects of design and presents a unifying framework called "Multidisciplinary System Design Optimization" (MSDO). We will always attempt to show the strengths of MSDO, but also its limitations in the greater qualitative context of design. A simple way to say this is: "Conceptual design and system architecting define the design vector, quantitative, computational design attempts to populate this vector with values that will lead to a good product or system". The objective of the course is to present tools and methodologies for performing system optimization in a multidisciplinary design context.

Recommend Readings:

1. *Uri Kirsch*: Structural Optimization: Fundamentals And Applications, ISBN 978-3-642-84845-2
2. *Uri Kirsch*: Optimum Structural Design Publisher: McGraw-Hill Inc.,US (March 1, 1981) Language: English, ISBN-10: 0070348448, ISBN-13: 978-0070348448
3. *Hibbler,* Structural Analysis, 7th edition, Prentice Hall "Fundamentals of Structural Analysis", McGraw-Hill 2002

Responsible of Subject: Professor Dr. Csébfalvi Anikó, CSc

Credits: 3

Numerical Modelling in Geotechnics

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: **Semester Mark**

Place of Subject in Curriculum: **2**

Prerequisites: *Numerical Methods*

Brief Syllabus: This course aims at teaching the basics of soil mechanics connecting to the geotechnical-numerical modeling and covers the following topics: mathematical models and computer programs, programming basic mechanism with excel, Finite Element Modeling (FEM).
This subject intends to provide students with knowledge in the basics of understand and program consolidation, settlements, bearing capacity of footings, equilibrium of gravity walls, embedded walls, bearing capacity of piles and anchorages. An additional objective is to prepare students with a basic knowledge for use Mohr-Coulomb,- Hardening-soil,- Soft-soil models and analyse geotechnical problems with FEM (e.g. sheet piles, retaining walls, slope stability) .

Recommend Readings:

1. *Bathe K.J. and Wilson E.L*, "Numerical Methods in Finite Element Analysis", Prentice Hall, Engle Wood Cliffs, New Jersey, USA, 1976
2. *Rubinstien*, M.F. “Matrix Computer Analysis of Structures Hall, 1966
3. *O. C. Zienkiewicz, R. L. Taylor, J.Z. Zhu*., "The Finite Element Method: Its Basis and Fundamentals: Its Basis and Fundamentals", ButterworthHeinemann, Sixth Edition, 2005

Responsible of Subject: Dr. Szűcs István, associate professor, CSc

Credits: 2

Case Studies in Geotechnics

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: This course aims at teaching the basics of geotechnical and soil mechanical problems and covers the following topics: Swelling of clay, foundation on organic soil, weak and compressible soil, failures of geotechnical structures and buildings.
This subject intends to provide students with knowledge in the case studies from all over the world (e.g. deep excavations, dams, building damages). An additional objective is to prepare students with a basic knowledge in Geomechanics of Failures (e.g. Collapse of compacted soil, dynamics of dam sliding).

Recommend Readings:

1. *Alexander M. Puzrin, Eduardo E. Alonso, Núria Pinyol* : Geomechanics of Failures. Springer 2010., ISBN: 978-90-481-3530-12.

2. *Alexander M. Puzrin, Eduardo E. Alonso, Núria Pinyol:* Geomechanics of Failures. Advanced Topics, Springer 2010., ISBN:978-90-481-3537-0

3. *Rolf Katzenbach, Jens Turek* - Interaction Between Structural and Geotechnical Engineers, 2003, ISBN-13: 978-0727731265 ISBN-10: 0727731262

4. Karoly Szechy: Foundation Failures, Butler & Tanner, 1961

Responsible of Subject: Dr. Szűcs István, associate professor, CSc

Credits: 2

Prestressed Concrete Structures

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: **2**

Prerequisites: *Advanced Structural Analysis*

Brief Syllabus: This course is aimed at providing basic and advanced knowledge on the mechanics, design and construction of prestressed concrete structures. Topics covered will include: basic concept of prestressing, prestressing systems and technologies, stress distribution in prestressed concrete structures, determination of prestress losses, flexural and shear behaviour at service and ultimate loads, deflection and crack control, design for serviceability and ultimate limit states, design of prestressed beams and slabs, external prestressing, strengthening with prestressing, durability and maintenance of prestressed concrete structures, case studies.

Recommend Readings:

1. *Naaman, A. E:* Prestressed Concrete Analysis and Design, 3rd edition, 2012., ISBN 13: 9780967493923
2. *Raiker, R.N.* "Learning from failures, Deficiencies in Design, Construction and Service", R&D Center, Raiker Bhavan, 1987, ISBN, 8190003712
3. *Allen.R.T., and Edwards.S.C.,* "Repairs of Concrete Structure", U.K.1987, ISBN 0-203-97392-5

Responsible of Subject: Dr Iványi M. Miklós, associate professor, DLA

Economics and Humanities

Credits: 2

Decision Support System

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 2.

Prerequisites: -

Brief Syllabus: This course serves as an introduction to decision support systems and methods. Course includes the theory of decisions and decision analysis. Uses commercial decision support and graphics software to build and solve business models such as linear programming, network models, transportation problems and decision tree. To achieve this, lectures are given in the following topics: Define decision model and describe its importance. Deterministic and probabilistic models, LP problems, sensitivity analysis, network models for service and manufacturing systems, transportation problems, CPM and MPM methods of task scheduling, decisions under uncertainty, risk taking, Bayesian decision analysis, multi-criteria analysis, multi-objective decision, capital budgeting and the use of computerized decision support systems.

Recommend Readings:

1. *Wayne L. Winston*, Operations Research: Applications and Algorithms, Cengage Learning, 2003, ISBN-13: 978-0534380588 ISBN-10: 0534380581
2. *Frederick S. Hillier, Gerald J. Lieberman*: Introduction To Operations Research, 7th edition, McGraw-Hill, 2000, ISBN-13: 978-0077298340 ISBN-10: 0077298349
3. *Collette, Y. and P. Siarry*, Multiobjective Optimization: Principles and Case Studies, Springer-Verlag, 2005, ISBN 3-540-40182-2
4. *Tsoukalas, L. and R. Uhrig*, Fuzzy and Neural Approaches in Engineering, John Wiley & Sons, 1997, ISBN 0-471-16003-2

Responsible of Subject: Dr. Szendrői Etelka, associate professor, PhD

Credits: 2

Engineering Practice in the EU 2.

Weekly Hours: 2 lectures, 0 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 3.

Prerequisites: -

Brief Syllabus: Course aims

The aim of the course is to introduce students to the conditions of practicing the engineering profession, job opportunities and starting an enterprise in EU countries, and to the European engineering associations.

Course content:

Engineers' licences in the fields of engineering. Working in designer or expert positions. Job opportunities. Business forms in the EU. Establishing a business, legal conditions, taxes. Types of contracts, the main parts of a contract. Fee charging for designer activity. Regulations of tenders and public procurement. European Quality Program (EQP).

The establishment, objectives and tasks of the European engineering associations.

- World Federation of Engineering Organisations (WFEO)
- Federation of Engineering Institutions of Asia and the Pacific (FEIAP)
- Commonwealth Engineers' Council (CEC)
- Asian Federation of Engineering Organisations (AFEO)
- Fédération Européenne d'Associations Nationales d'Ingénieurs (FEANI - European Federation of National Engineering Associations
- European Network for Accreditation of Engineering Education (ENAEE)
- EUR-ACE Accord
- European Federation of Productivity Services

Compulsory course materials:

- Europe 2020 - Europe's growth strategy - growing to a sustainable and job-rich future
- Horizon 2020 - Open to the world! - How to participate?
- Ready to make the move? - What you need to know about living and working abroad – and so much more

Recommend Readings:

1. http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aias075922.pdf
2. The UIA Agreement on the Rules of Recommended International Professional Employment
3. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:255:0022:0142:hu:PDF

Responsible of Subject: Dr. Szabó Éva, associate professor, DLA

Credits: 4

Engineering Ethics and Attitude

Weekly Hours: 2 lectures, 2 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: 3.

Prerequisites: -

Brief Syllabus: Engineering Ethics and Attitude is designed to introduce engineering graduate students to the concepts, theory and practice of engineering ethics and effective written and oral communications and presentations. Students apply classical moral theory and decision making to engineering applications encountered in academic and professional careers.
The purpose of this course is to help future engineers be prepared for confronting and resolving ethical issues that they might encounter during their professional careers. It gives an overview of the moral problems engineers face in their different social roles, and it provides conceptual tools and methods necessary for pursuing those issues. Topics include engineering professionalism; social roles of engineers; ethical theories; ethical decision making techniques; social impacts of engineering, professional organizations; code of ethics of engineering societies. Case studies are discussed in a practice oriented approach. The primary goal is to stimulate critical and responsible reflection on moral issues surrounding engineering practice.

Recommend Readings:

1. *Seebauer, E. G. and R. L. Barry*, Fundamentals of Ethics for Scientists and Engineers,: 2000, 1St Edition ISBN number: 9780195134889
2. *Charles Fleddermann*: Engineering Ethics, Pearson Education, 2013,ISBN: 1292012528
3. *Caroline Whitback*: Ethics in Engineering Practice and Research , Cambridge University Press, 2011, ISBN: 0521723981

Responsible of Subject: Dr. Nagy Enikő, assistant professor, PhD

Elective Subjects

Credits: 2

Advanced Design of Bridges

Weekly Hours: 2 lectures, 2 practice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: **3**

Prerequisites: *Advanced Structural Analysis, Advanced Structural Dynamics*

Brief Syllabus: Characteristics of classical and modern bridge structures. Bending, shear, torsion and distortion of plated and thin-walled bar elements. The "shear lag" effect. Stability examination of bar- and plated structures. Effect of plate bracings. Behaviour of cable structures. Strength and stability examinations of suspension and cable bridges.

Recommend Readings:

1. *Johnson Victor D.,* "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.
2. *Krishna Raju.N.* "Design of Bridges", fourth editionOxford & IBM Publishing Co, Bombay, 2009.
3. *Raina.V.K.* "Concrete Bridge Practice", Tata McGraw Hill Publishi Co., New Delhi - 1991
4. *Taylor F.W*, Thomson S.E. and Smulski.E. "Reinforced Concrete Bridges", John Wiley & Sons, New York 1955

Responsible of Subject: Dr. Iványi M. Miklós, associate professor, DLA

Credits: 3

Seismic Design

Weekly Hours: 2 lectures, 0 prctice, 0 lab.

Language of Instructions: English

Grading: Semester Mark

Place of Subject in Curriculum: **3**

Prerequisites: *Advanced Structural Analysis, Advanced Structural Dynamics*

Brief Syllabus: This course provides a comprehensive introduction to the earthquakes damages, principles of seismic behaviour, analysis and design of structures. The aim is to provide basic understanding and skills to carry out conceptual design of earthquake-resistant building.
Introduction to earthquake engineering. Basics of seismology, earthquake characteristics and effects of earthquakes on structures. Ground motions, site effects and liquefaction. Understanding of dynamic behaviour of structures under seismic excitation. Seismic provisions of design codes (EUROCODE 1 and 8, ASCE/SEI 7-10). General principles of the structural design and seismic-resistant concrete and steel structures. Serviceability and ultimate limit states for structures. Methods for seismic analysis and design of structures: quasi-static load approach, response spectrum methods, and time-history analysis. Soil-structure interaction. Assessment and retrofitting of existing structures (ASCE 41-13, FEMA-547, EUROCODE 8, Part 3). Risk assessment. Mitigation of seismic effects.

Recommend Readings:

1.*K. Chopra*, Dynamics of Structures, Theory and Applications to Earthquake Engineering, fourth edition, Prentice Hall, 2012
2.Institution of Structural Engineers/AFPS. Manual for the design of steel and concrete buildings to Eurocode 8. October 2010.
3.*Fardis M et* al. Designers' guide to EN1998 (Pts 1 & 5).Thomas Telford, London, 2005.
4.*Fardis M.*Seismic design, assessment and retrofitting of concrete buildings, based on EN-Eurocode 8. Springer 2009.
5.*Elghazouli A* Design of buildings to EC8. Taylor and Francis, 2009.

Responsible of Subject: Professor Dr. Katona Tamás, DSc