INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT GENIE CIVIL ET URBANISME
CIVIL ENGINEERING AND URBANISM
INSA Campus LyonTech - 8 rue des Sports
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Projects

Building design: multidisciplinary approach

IDENTIFICATION

CODE : GCU-S8-M8
ECTS : 5.0

HOURS

Lectures :	16.0 h
Seminars :	8.0 h
Laboratory :	0.0 h
Project :	46.0 h
Teacher-student contact :	70.0 h
Personal work :	55.0 h
Total :	125.0 h

ASSESSMENT METHOD

Ongoing evaluation [33%]
Oral defence of the project [33%]
Written exam [33%]

TEACHING AIDS

MATLAB / Octave
Photocopies

TEACHING LANGUAGE

English

CONTACT

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AIMS

This module is part of the course unit GCU-S8-M8 and contributes to:

Competences in Engineering Science:
A1- Analyze a real or virtual system [or problem] [Level 3]
A2- Operate a model of a real or virtual system [Level 3]
A6- Communicate a scientific analysis or approach [Level 3]

Competences in Humanities, Documentation and Physical and Sports Education:
B1- Know oneself; manage mental and physical fitness [Level 1]
B2- Work, learn, progress autonomously [Level 3]
B3- Interact with others, work as a team [Level 3]
B4- Demonstrate creativity, innovate and undertake [Level 3]
B5- Act responsibly in a complex world [Level 2]

Competences specific to the specialty:
C1- Perform, interpret a geological profile, interpret a map or remote sensing result, identify a geological horizon
C6- Design, dimension, model or verify foundation and retaining systems;
C7- Building structure [design, dimension and control a¿]
C15- Design and control good technical solutions for buildings in terms of thermal, airflow, acoustics
C17- Designing and sizing networks and structures based on hydrologic and hydraulic approaches for urban planning, buildings and civil engineering infrastructures
C23- Contribute to a pluri-disciplinary design process of buildings

CONTENT

Design a building by using fundamental principles.
Draw plans at scale 1/200.
Develop the ability to implement design methods into algorithms.
Optimise solutions.
Collaborate in order to solve complex problems.

Programme of professional specialities
Geotechnics
- Assess of a superficial foundation system by elastic finite element method [MATLAB Implementation].
- Assess the bearing capacity of the foundation by an elasto-plastic method: a standard elasto-plastic constitutive model using Drücker-Prager criterion has to be developed and implemented in an existing finite element code.

Structures
- Design of a beam-and-post structure.
- Develop of a Finite Element model based on Navier-Bernoulli beam elements [under MATLAB] in 2D and linear elasticity.
- Assess the internal forces and the maximum displacements and define the cross-sections dimension according to the considered material.
- Analyse the effect on the design of different loading scenarios [dead weight, wind, operating load, etc.].

Energy
- Calculate the thermal load [MATLAB implementation]
- Size the heating and air conditioning systems
- Estimate the thermal performance [MATLAB implementation]
- Optimise the thermal behaviour of the building

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Hydraulics - pressurized flows
Design and size a water distribution network.
Compute flow rate distribution in a water supply network with respect of water demand and operating pressures (MATLAB implementation).
Propose a reliable technical option for a sustainable water management at the building scale (water harvesting, reuse for various purposes, etc.).

BIBLIOGRAPHY

1. H. Moore (2011) MATLAB for Engineers, Pearson Education
2. C. Ghiaus (2013) Causality issue in the heat balance method for calculating the design heating and cooling load, Energy (50), p. 292-301
3. C. Ghiaus (2014) Linear algebra solution to psychometric analysis of air-conditioning systems, Energy (24), p. 555-566
4. Amiroudine, S., & Battaglia, J. L. (2017). Mécanique des fluides-3e éd.: Cours, 70 exercices corrigés. Dunod.
5. Comolet, R. (2006). Mécanique expérimentale des fluides. vol 2, 4e éd. Dunod.
6. Batoz J-. L. et Gouri Ghatt., Modélisation des structures par éléments finis. Hermès, 1990
7. Cazenaze, M. Méthode des éléments finis - Approche pratique en mécanique des structures Dunod, 2010
8. Zienkiewicz, O. & Taylor, R. The finite element method for solid and structural mechanics 1967
9. Philipponnat G., Hubert B., (2016). Fondations et ouvrages en terre, Eyrolles
10. Prunier F., (2017). Description du comportement des géomatériaux, cours INSA Lyon

PRE-REQUISITE

Documentary research (PC-S1-DOC)

Algorithms and computer programming (PC-S1-IF)
Algorithms and computer programming (PC-S2-IF)
Algorithms and computer programming (PC-S3-IF)
Algorithms and computer programming (PC-S4-IF)

Numerical toolboxes (PC-S1-ON)
Mathematics for applied sciences (PC-S1-OM)
Mathematics for applied sciences (PC-S1-OM-P)

Numerical toolboxes (GCU-S5-ONUM)
Geotechnics 1 : Identification of soils and hydraulics (GCU-S5-GEO-1)
Geotechnics 2 : Soil mechanics (GCU-S6-GEO-2)

Structural analysis methods (GCU-S6-MAS-1 et GCU-S6-MAS-2)
Initiation to structural analysis (GCU-S5-IAS1 et GCU-S5-IAS2)
Continuum Solid Mechanics (GCU-S5-MMC)

Thermodynamics (PC-S2-TH)
Heat transfer (GCU-S5-TC)
Thermo-aerodynamics behaviour of buildings (GCU-S5-THB)
Air conditioning (GCU-S6-CLI)

Fluid mechanics (GCU-S6-MF)

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