SUBJECT DATASHEET

I. SUBJECT SPECIFICATION

1 BASIC DATA

1.1 Title

BRIDGES AND INFRASTRUCTURES

1.2 Code

BMEEOHSAS43

1.3 Type

Module with associated contact hours

1.4 Contact hours

type	hours/week
lectures	2

1.5 Evaluation

examination

1.6 Credits

3

1.7 Coordinator

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academic rank:	associate professor
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1.8 Department

Department of Structural Engineering (www.epito.bme.hu/hidak-es-szerkezetek-tanszek)

1.9 Website

www.epito.bme.hu/**BMEEOHSAS43**

1.10 Language of instruction

Hungarian and English

1.11 Curriculum requirements

Compulsory in the Structural engineering (BSc) programme

Alternative compulsory in the Infrastructure engineering (BSc) programme

Alternative compulsory in the Geoinformatic engineering (BSc) programme

1.12 Prerequisites

Required previous subjects (need to be completed to register)

Steel structures (BMEEOHSAT42)

Reinforced concrete structures (BMEEOHSAT43)

1.13 Effective date

Sepember 1, 2017.

2 OBJECTIVES AND LEARNING OUTCOMES

2.1 Objectives

The primary aim of the course is to provide the students with basic knowledge on the functional and structural design principles as well as the structural behaviour of bridges and key objects of the infrastructure. During the semester the following topics are discussed: historical development, basic terms and classification of bridges; superstructure systems, typical superstructures of steel, steel and concrete composite as well as concrete bridges; composite action between main girders; basis of bridge design, traffic load models and their application rules for highway and railway bridges; substructures of bridges (abutments and piers), bridge equipment; conceptual design of bridges (fitting of bridges into environment, bridge aesthetics); civil engineering work of traffic infrastructure, water-supply and waste-water systems and hydraulic engineering.

2.2 Learning outcomes

Upon successful completion of this subject, the student:

A. Knowledge
   1. knows the historical development, the structural systems and the structural behaviour of bridges,
   2. knows the material-dependent superstructure systems, their mayor parts and behaviour,
   3. knows the particularities of moving loads, the principles of critical load positioning, the traffic load models of bridges and their application rules,
   4. knows the typical substructure types, their parts and behaviour,
   5. knows the principles of conceptual bridge design,
   6. knows the key objects of traffic infrastructure, water-supply and waste-water systems and hydraulic engineering and the structural aspects of their functioning,

B. Skills
   1. capable of numerical modelling and analysis for grid-type superstructures,
   2. capable of defining and positioning of the traffic loads on bridges as well as combining them with other non-traffic actions,
   3. able to calculate the extremities of internal forces and stresses at given locations of grid-type superstructures,
   4. able to numerically verify the most important structural requirements of bridges,

C. Attitudes
   1. cooperates with the lecturer,
   2. improves his/her knowledge by consecutive learning activities,
   3. open to use numerical software,
   4. makes effort to perform exact and error-free calculations,
   5. makes effort to understand the structural behavior of bridges and to acquire their design procedures,
   6. makes effort to apply cost-effective and sustainable structural solutions.

D. Autonomy and responsibility
   1. capable of modelling grid-type superstructures and performing their preliminary structural analysis without mayor help,
   2. individually capable of justifying the exactness of new structural solutions and their basic application,
   3. uses systematized thinking approach.

2.3 Methods

Lectures, individually performed homework (modelling and verification tasks), written and oral communication, use of IT tools and techniques.

2.4 Course outline

week:	Topics of lectures and/or exercise classes
1.	Historical development of bridges. Basic terms of bridges. Classification of bridges (function, structural system, material etc.). Typical features of basic structural systems. Relation between structure and flow of forces. Superstructure systems.
2.	Conceptual design of bridges (geotechnical conditions, selection of structural system and material, positioning of supports, selection of cross-section for superstructure, drainage system etc.). Fitting of bridges into environment, bridge aesthetics.
3.	Basis of bridge design (design concept, codes). Overview of actions on bridges (permanent, variable, accidental, seismic). Traffic load models for highway and railway bridges.
4.	Design of a grid-type superstructure
5.	Application rules for traffic load models. Simultaneity of traffic loads with other actions (example).
6.	Superstructures of steel girder bridges (grid systems: longitudinal and transversal beams, solid and truss systems; box girders; deck slabs). Arrangement of structural elements, essence of flow of forces. Composite action of main girders (influence line).
7.	Superstructures of steel and concrete composite girder bridges (grid systems: longitudinal and transversal beams, solid and truss systems; box girders; concrete deck slab; shear connection). Arrangement of structural elements, essence of flow of forces. Composite action of main girders (influence line).
8.	Superstructures of concrete girder bridges (plates, grid systems, precast multiple girder superstructures, box girders). Arrangement of structural elements, essence of flow of forces. Composite action of main girders (influence line).
9.	Substructures of bridges: abutments and piers (structural system, flow of forces).
10.	Bridge equipment (bearings, dilatations, restraining systems, drainage).
11.	Erection systems of steel and concrete bridges.
12.	Civil engineering work in traffic infrastructure, structural systems, flow of forces, typical structures
13.	Civil engineering work in water-supply and waste-water systems, structural systems, flow of forces, typical structures
14.	Civil engineering work in hydraulic engineering. Overview of actions on infrastructural work, basis of structural design

The above programme is tentative and subject to changes due to calendar variations and other reasons specific to the actual semester. Consult the effective detailed course schedule of the course on the subject website.

2.5 Study materials

a) Textbooks

1. Hirt, M., Lebet, J-P.: Steel Bridges: Conceptual and Structural Design of Steel and Steel-Concrete Composite Bridges, 1st edition, EPFL Press, Lausanne, 2013 ISBN-13 978-1-4665-7296-6 (recommended)
2. Iványi M.: Hídépítés, Műegyetemi Kiadó, Budapest, 1998, ISBN 963 420 478 X, pp. 18-75. (recommended)

3. White, K.R., Minor, J., Derucher, K.N.: Bridge Maintenance Inspection and Evaluation, Second edition, Marcel Dekker Inc., New York, 1992 ISBN 0-8247-8609-2, pp. 101-116., pp. 121-124., pp. 131-141. (recommended)
4. Pipinato, A. (Ed.): Innovative Bridge Design Handbook – Construction, Rehabilitation and Maintenance, Elsevier, 2016, ISBN: 978-0-12-800058-8 (recommended)

b) Online materials
   1. Structural analysis of a grid-type road bridge superstructure (manual to homework)

2.6 Other information

1) The homework focuses on the numerical modelling and the most important structural verifications of a grid-type superstructure. The homework shall be completed individually in steps (subtasks related to midterms) with oral consultation. Midterms are considered to be fulfilled when the related results are uploaded into a given database until the related deadline. Consultation on topics related to expired midterm is not available.
2) Solution of subtasks of homework are presented in lectures outside the official schedule. Attendance on these lectures is optional.

2.7 Consultation

The instructors are available for consultation during their office hours, as advertised on the department website. Special appointments can be requested via e-mail: kovacs.tamas@epito.bme.hu

II. SUBJECT REQUIREMENTS

3 ASSESSEMENT AND EVALUATION OF THE LEARNING OUTCOMES

3.1 General rules

The assessment of the learning outcomes specified in clause 2.2. above and the evaluation of student performance occurs via one homework (30 points) during the semester and a written exam (70 points) at the end of the semester. In total 100 points (100%) are acquirable.

3.2 Assessment methods

Evaluation form	abbrev.	**assessed learning outcomes**
Homework	HW	A.1-A.3; B.1-B.4; C.1-C.6; D.1
Exam (synthetized evaluation)	E	A.1-A.6; C.1-C.2; C.4-C.6; D.2-D.3

The dates of midterm deadlines of homework are found in the "detailed subject requirements" on the subject's website.

3.3 Evaluation system

abbreviation	**score**
HW	30%
exam	70%
Total	**100%**

3.4 Requirements and validity of signature

1) Attendance on at least 70% of lectures.

2) Successful submission of homework (min. 50%).

3.5 Grading system

The final grade is determined as follows:

grade	**points (P)**
excellent (5)	85<=P
good (4)	75<=P<85%
satisfactory (3)	65<=P<75%
passed (2)	50<=P<65%
failed (1)	P<50%

3.6 Retake and repeat

1) If the result of the homework submitted until the submission deadline set in the detailed subject requirements remains below 50% according to clause 3.4 above, the homework may be improved until the improvement deadline set in the detailed subject requirements but is subject to payment of repetition fee. The improved homework cannot be evaluated higher than 50%. Students submitting improved homework cannot take part in pre-exam.
2) The homework not submitted until the submission deadline set in the detailed subject requirements may be submitted until the retake deadline set in the detailed subject requirements but is subject to payment of repetition fee. Homework submitted after the submission deadline (retake of submission) cannot be improved and the related student cannot take part in pre-exam.

3) If the result of either improved or retaken homework remains below 50% according to clause 3.4 above, or when the improvement deadline has been missed, the signature of the subject shall be refused.
4) Improvement of already successful exam result is only possible in the last exam of the related semester.

3.7 Estimated workload

Total: 3 credits × 30 hours/credits = 90 hours/semester.

activity	**hours/semester**
contact hours	14×2=28
homework	5+10+15=40
preparation for the exam	22
in total	**90**

3.8 Effective date

February 1, 2019.