Bridges and Infrastructures - BMEEOHSAS43

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 / (days)
Lecture	2

1.5 Evaluation

Exam

1.6 Credits

3

1.7 Coordinator

name	Dr. Jáger Bence
academic rank	Assistant professor
email	jager.bence@emk.bme.hu

1.8 Department

Department of Structural Engineering

1.9 Website

https://epito.bme.hu/BMEEOHSAS43
https://fiek2.mywire.org/course/view.php?id=445

1.10 Language of instruction

hungarian and english

1.11 Curriculum requirements

Compulsory in the Specialization in Structural Engineering (BSc) programme

1.12 Prerequisites

Strong prerequisites:

- Steel Structures (BMEEOHSAT42)
- Reinforced Concrete Structures (BMEEOHSAT43)

1.13 Effective date

1 September 2022

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,

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:

- 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)
- Iványi M.: Hídépítés, Műegyetemi Kiadó, Budapest, 1998, ISBN 963 420 478 X, pp. 18-75. (recommended)
- 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)
- Pipinato, A. (Ed.): Innovative Bridge Design Handbook - Construction, Rehabilitation and Maintenance, Elsevier, 2016, ISBN: 978-0-12-800058-8 (recommended)

b) Online materials:

- Structural analysis of a grid-type road bridge superstructure (manual to

2.6 Other information

1. The homework focuses on the numerical analysis and the most important structural verifications of a grid-type superstructure. The homework shall be completed individually with oral consultation.

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 as follows: homework: jager.bence@emk.bme.hu; otherwise: kovacs.tamas@emk.bme.hu

Bridges and Infrastructures - BMEEOHSAS43

This Subject Datasheet is valid for:

2023/2024 semester I

II. Subject requirements

Assessment 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 an oral exam (70 points) at the end of the semester. In total 100 points (100%) are acquirable.

3.2 Assessment methods

Evaluation form	Abbreviation	Assessed learning outcomes
Homework, Midterm#1 (midterm evaluation)	HW1	A.2-A.3; B.1-B.4; C.1-C.3, C.4-C.5; D.1
Exam (synthetized evaluation)	E	A.1-A.6; C.1-C.2, C.4-C.5; D.2-D.3

The dates of deadlines of assignments/homework can be found in the detailed course schedule 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

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. The submission deadline for homework is set in the detailed subject requirements.

2. The homework not submitted until the submission deadline may be submitted until the retake deadline set in the detailed subject requirements but is subject to payment of repetition fee. No homework submission is alowed after the retake deadline.
3. If the result of homework remains below 50% (according to clause 3.4 above), also incuding missed submissions, the signature of the subject shall be refused.
4. Retake of an already successful exam is allowed as a subsequent exam in the same exam period. The result of the last exam in the exam period becomes official.

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
Sum	**90**

3.8 Effective date

1 September 2022

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2023/2024 semester I