# SUBJECT DATASHEET

# I. SUBJECT SPECIFICATION

## 1 BASIC DATA

*1.1 Title*

**SEISMIC DESIGN**

*1.2 Code*

**BMEEOHSMT-3**

*1.3 Type*

Module with associated contact hours

*1.4 Contact hours*

| type | hours/week |
|---|---|
| lectures | 2 |
| seminars/exercise classes | 1 |

*1.5 Evaluation*

midterm grade

*1.6 Credits*

4

*1.7 Coordinator*


name: Dr. László Gergely Vigh
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/BMEEOHSMT-3

*1.10 Language of instruction*

Hungarian and English

*1.11 Curriculum requirements*

Compulsory in the Specialization of Structures of the Structural Engineering (MSc) programme
Optional in the Structural Engineering (MSc) programme

*1.12 Prerequisites*

Recommended subjects

Structures 1 (BMEEOHSMS51)
Structural Dynamics (BMEEOTMMN-1 or BMEEOTMMBT3)

Exclusive subjects (one shall not register if any of the subjects below has been completed)

Seismic Design (BMEEOHSMC03)

*1.13 Effective date*

September 1, 2017.

## 2 OBJECTIVES AND LEARNING OUTCOMES

### *2.1 Objectives*

The objective of the course is that the student shall understand the description and characterization of seismic effects and consequences, shall be aware of the basic principles of vibration analysis, behaviour, analysis and design of single and multi degree of freedom elastic or elasto-plastic structural systems, simplified modelling techniques of structures, principles of design regulations and codes, behaviour and design methods of quasi-elastic and dissipative structures.

### *2.2 Learning outcomes*

Upon successful completion of this subject, the student:

A. Knowledge
   1. understands the sources of earthquakes, is aware of the properties characterizing the effects and consequences of earthquakes, knows the major parameters describing the seismic effects on structures,
   2. is aware of the principles of vibration analysis and the basic parameters describing and influencing vibration of single and multi degree of freedom systems,
   3. is aware of the elastic and design response spectra and the lateral force method ,
   4. knows the basic analysis procedures for seismic analysis of structures,
   5. is aware of the regulation background of seismic design, principles and major regulations of standards,
   6. is able to distinguish the concepts of quasi-elastic and dissipative design, understands the behaviour, analysis and design principles of dissipative structures, major standardized design methods,

B. Skills
   1. computes vibration parameters (fundamental period, vibration modes) of single and multi degree of freedom systems, using manual or computer-aided numerical methods,
   2. develop simplified equivalent modells of multi degree of freedom systems,
   3. applies the lateral force method in practice,
   4. applies the modal response spectrum analysis in practice,
   5. is able to develop 3D numerical model for the seismic analysis of complex structural systems, completes the seismic analysis and the evaluation of its results,
   6. completes the seismic analysis and design of quasi-elastic/dissipative building/bridge structures and their foundation according to the standards,

C. Attitudes
   1. collaborates with the teacher and the student fellows in gaining knowledge,
   2. is continuously gaining knowledge,
   3. is open to the use of IT tools and equipments,
   4. makes effort to understand and to use the tools of seismic analysis and design,
   5. aims accuracy in his/her calculations/solutions,
   6. aims understanding the criticism,
   7. applies self-checking of his/her calcuations, corrects the mistakes,

D. Autonomy and responsibility
   1. completes seismic design in full accordance to the pirnicpal rules of standards and regulations,
   2. is independent in problem statements and solutions,
   3. in situations of group works, collaborates with his/her student fellows,
   4. aims understanding the complexity, comprehensiveness of the problems and recognizing the synergies.

### *2.3 Methods*

Lectures, computational practices, active involvement in and exchange of thoughts during lectures, communication in oral and written form, use IT tools and equipments, tasks to be solved individually or in group work

*2.4 Course outline*

week Topics of lectures and/or exercise classes

1. Introduction: Earthquakes and its characterization. Phenomena, behaviour, seismic parameters. Structures and seismic effects, damages, consequences.
2. Basis of vibration dynamics. Time history analysis of elastic SDOF systems. Response spectra. Lateral static force method.
3. Simplified dynamic modelling of structures. Computational practice: simplified models of structures.
4. Influence of ductility, plasticity. Principles of dissipative design concept, analysis methods.
5. Multi degree freedom systems. Modal analysis, modal response spectrum analysis. Lateral static force method.
6. Summary. Analysis and design in accordance to Eurocode 8.
7. Computational practice: design of quasi-elastic structures according to the Eurocode 8.
8. Principles of dissipative structural design.
9. Foundation of dissipative structures, soil-structure interaction and special problems.
10. Conventional (quasi-elastic) and dissipative steel structures.
11. Conventional (quasi-elastic) and dissipative RC and composite structures.
12. Bridge structures. Computational practice: dissipative structural design.
13. Damping devices and special problems.
14. Summary. Consultation.

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, literature
    1. Vigh, L.G., Hortobágyi, Zs., Pohl, Á., Joó, A.: Szerkezetek szeizmikus analízise számítógéppel - Példatár, TERC Kiadó, 2013
    2. Dulácska, E., Joó, A., Kollár, L.: Tartószerkezetek tervezése földrengési hatásokra, Akadémiai Kiadó, 2008
    3. Chopra, Anil K: Dynamics of Structures: Theory and Applications to Earthq. Eng., Prentince-Hall, 1995
    4. Mazzolani, F.M., Piluso, V.: Theory and Design of Seismic Resistant Steel Frames, E&FN Spon, 1996
b) Online materials: materials uploaded to the web site of the subject, e.g.:
    1. presentation slides of lectures and practices
    2. solved problems for detailed and simplified modelling of structures, numerical analysis, time-history analysis
    3. guidelines for modelling and analysis of buildings, bridges and foundations
    4. midterm test samples with solution

*2.6 Other information*

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*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.

# II. SUBJECT REQUIREMENTS

## 3 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 tests, homework assignments and class work.

### *3.2 Assessment methods*

| **Type of evaluation** | abbrev. | **assessed learning outcomes** |
|---|---|---|
| Midterm control test #1 | ED1 | A.1-A.4, B.1, C.2, C.5-C.7, D.2, D.4 |
| Midterm control test #2 | ED2 | A.4-A.6, C.2, C.5-C.7, D.2, D.4 |
| Homework #1 | HF1 | B.1-B.3, C.1-C.7, D.1-D.4 |
| Homework #2 | HF2 | B.3-B.6, C.1-C.7, D.1-D.4 |
| active involvement in lectures | A | A.1-A.6, B.1-B.6, C.1-C.7, D.1-D.4 |

The dates of midterm tests and deadlines of assignments/homework can be found in the detailed course schedule on the subject's website.

### *3.3 Evaluation system*

| **abbreviation** | **score** |
|---|---|
| ED1 | 25% |
| ED2 | 25% |
| HF1 | 10% |
| HF2 | 30% |
| A | 10% |
| **Total in semester** | **100%** |
| **Sum** | **100%** |

An ED is failed if min 50% of the total achievable point is not achieved.
Each student has consultation record sheet for the homeworks. The supervisor evaluates each student separately during consultations. Homeworks are also graded (in case of group work parts, all member of the group will obtain the same points), which is added to the consultation points. Homework is failed if the sum of the homework and consultation points HF1 + HF2 does not reach 50% of the achievable points.

### *3.4 Requirements and validity of signature*

No signature can be obtained.

### *3.5 Grading system*

To obtain successful grade, attendance requirement must be fulfilled.
Semester grade is failed, if any of the following applies:

- ED1 is failed if the gained points do not achieve 50% of the achievable points.
- ED2 is failed if the gained points do not achieve 50% of the achievable points.
- Homework is failed if the sum of the homework and consultation points HF1 + HF2 does not reach 50% of the achievable points.

The final grade is computed on the basis of the sum of ED1 + ED2 + HF1 + HF2 + A, as follows:

| **grade** | **points (P)** |
|---|---|
| excellent (5) | 85<=P |
| good (4) | 75<=P<85% |
| satisfactory (3) | 60<=P<75% |
| passed (2) | 50<=P<60% |
| failed (1) | P<50% |

*3.6 Retake and repeat*

1) Each ED can be repeated (2nd attempt) during the last week of the study period of the semester.
2) ONE of the two EDs on request can be also repeated during the supplementary week (3rd attempt) (penalty fee applies).
3) Late submission of HF1 is possible one week after the original deadline electronically via the website of the subject. (penalty fee applies)
4) Late submission of HF2 is possible on the first day of the exam period by 12:00, electronically via the website of the subject. (penalty fee applies)
5) "Active involvement in lectures" A cannot be repeated, cannot be substituted with other forms of activity.

*3.7 Estimated workload*

| **activity** | **hours/semester** |
|---|---|
| contact hours | 14×3 = 42 |
| preparation for the lectures | 14×0,5 = 7 |
| preparation for the tests | 14×0,5+2×8 = 23 |
| homework | 43 |
| home studying of the written material | 5 |
| **in total** | **120** |

*3.8 Effective date*

September 1, 2017.