



Subject card

|                                             |                                                                                                                                                                                                                                                    |                                                                                                  |          |                                     |                                                                                                                      |            |     |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------|-----|
| Subject name and code                       | Reliability of structures, PG_00041525                                                                                                                                                                                                             |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Field of study                              | Civil Engineering                                                                                                                                                                                                                                  |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Date of commencement of studies             | October 2023                                                                                                                                                                                                                                       | Academic year of realisation of subject                                                          |          |                                     | 2024/2025                                                                                                            |            |     |
| Education level                             | second-cycle studies                                                                                                                                                                                                                               | Subject group                                                                                    |          |                                     | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |            |     |
| Mode of study                               | Full-time studies                                                                                                                                                                                                                                  | Mode of delivery                                                                                 |          |                                     | at the university                                                                                                    |            |     |
| Year of study                               | 2                                                                                                                                                                                                                                                  | Language of instruction                                                                          |          |                                     | English                                                                                                              |            |     |
| Semester of study                           | 3                                                                                                                                                                                                                                                  | ECTS credits                                                                                     |          |                                     | 3.0                                                                                                                  |            |     |
| Learning profile                            | general academic profile                                                                                                                                                                                                                           | Assessment form                                                                                  |          |                                     | assessment                                                                                                           |            |     |
| Conducting unit                             | Department of Structural Mechanics -> Faculty of Civil and Environmental Engineering                                                                                                                                                               |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                 | dr inż. Marek Skowronek                                                                          |          |                                     |                                                                                                                      |            |     |
|                                             | Teachers                                                                                                                                                                                                                                           |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Lesson types and methods of instruction     | Lesson type                                                                                                                                                                                                                                        | Lecture                                                                                          | Tutorial | Laboratory                          | Project                                                                                                              | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                              | 30.0                                                                                             | 15.0     | 0.0                                 | 0.0                                                                                                                  | 0.0        | 45  |
|                                             | E-learning hours included: 0.0                                                                                                                                                                                                                     |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Learning activity and number of study hours | Learning activity                                                                                                                                                                                                                                  | Participation in didactic classes included in study plan                                         |          | Participation in consultation hours |                                                                                                                      | Self-study | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                              | 45                                                                                               |          | 5.0                                 |                                                                                                                      | 25.0       | 75  |
| Subject objectives                          | General information on uncertainty modelling in engineering analysis and design<br>Distinction of three levels of reliability assessment, their domain and relevant operational methods                                                            |                                                                                                  |          |                                     |                                                                                                                      |            |     |
| Learning outcomes                           | Course outcome                                                                                                                                                                                                                                     | Subject outcome                                                                                  |          |                                     | Method of verification                                                                                               |            |     |
|                                             | [K7_W04] has knowledge on advanced strength of materials, modeling and optimisation of materials and constructions; has knowledge of fundamentals of Finite Element Method and general nonlinear analysis of engineering constructions and systems | The student adjusts a relevant reliability assessment method to the specified engineering task   |          |                                     | [SW1] Assessment of factual knowledge                                                                                |            |     |
|                                             | [K7_W16] knows methods of diagnostics of engineering objects, has knowledge about different kinds of defects in constructions and its reasons; knows means of fixing and reinforcing of constructions.                                             | The student recognizes basic uncertainty sources decisive for structural reliability             |          |                                     | [SW1] Assessment of factual knowledge                                                                                |            |     |
|                                             | [K7_U16] is able to estimate the technical condition of engineering object; can interpret the results of constructions and materials examination;                                                                                                  | The student performs numerical reliability assessment on a prescribed level                      |          |                                     | [SU1] Assessment of task fulfilment                                                                                  |            |     |
|                                             | [K7_U11] is able to plan and execute laboratory experiments to evaluate quality of construction materials and to determine strength of construction elements                                                                                       | The student recognizes the uncertainty origins in the process of engineering analysis and design |          |                                     | [SU1] Assessment of task fulfilment                                                                                  |            |     |
|                                             | [K7_U03] can perform classic statical and dynamical analysis of rod structures stability (trusses, frames and ties), both statically determined and undetermined as well as surface structures (plates, membranes and shells)                      | The student performs numerical reliability assessment on a prescribed level                      |          |                                     | [SU1] Assessment of task fulfilment                                                                                  |            |     |

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|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Subject contents                                               | Probability theory - preliminaries.<br>Probabilistic models for load and resistance variables. Basic definitions - reliability, failure probability.<br>Random modelling of load and resistance variables. Reliability of structural systems.<br>Levels of reliability methods – classification. Level I methods - application to standards and codes, partial safety factors.<br>Level II methods – safety indices.<br>Level III method - numerical procedures. Monte Carlo simulation, engineering examples.<br>Random load combination. Time-variant reliability analysis. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Prerequisites and co-requisites                                | Structural mechanics, strength of materials, mathematics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Assessment methods and criteria                                | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Percentage of the final grade |
|                                                                | activity, presentations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10.0%                         |
|                                                                | tests                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 90.0%                         |
| Recommended reading                                            | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"> <li>1. Ang A. H-S., Tang W.H. Probability concepts in engineering. Wiley Chichester 2007</li> <li>2. Hart G. Uncertainty analysis of loads and safety in structural engineering. Prentice Hall Englewood Cliffs 1982</li> <li>3. Madsen H.O., Krenk S., Lind N.C. Methods of structural safety. Prentice Hall Englewood Cliffs 1986</li> <li>4. Nowak A. Collins K. Reliability of structures. McGraw Hill New York 2000.</li> </ol>                                                                                                                                                                                                                                        |                               |
|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li>1. Augusti G., Baratta A., Casciati F. Probabilistic methods in structural engineering. Chapman &amp; Hall, London 1984</li> <li>2. Ditlevsen O., Madsen H. Structural reliability methods. Wiley Chichester 1996, <a href="http://www.mek/dtu.dk/staff/od/books.htm">www.mek/dtu.dk/staff/od/books.htm</a></li> <li>3. Thoft-Christensen P., Baker M.J. Structural reliability theory and its applications. Springer Berlin 1982</li> <li>4. Thoft-Christensen P., Murotsu Y. Application of structural system reliability theory. Springer Berlin 1986</li> <li>5. Melchers R. Structural reliability Analysis and prediction. John Wiley Chichester 1999.</li> </ol> |                               |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Adresy na platformie eNauczanie:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Example issues/<br>example questions/<br>tasks being completed | Three levels of reliability assessment, short description<br>Basic Monte Carlo simulation algorithm adjusted to engineering problems                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |

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