STRUCTURAL STABILITY

Subject code: **06.4-WILŚ- BUD- STK- KC05**

Subject type: Obligatory

Language of instruction: English

Responsible for the subject: Prof. Jakub Marcinowski, D.SC. Eng.

Providing education: Department of Building Structures

Type of class	Number of classes per semester	Number of classes per week	Semester	Type of credit test	ECTS points
Full time studies					3
Lecture	15	1	II	credit with a grade	
Project	15	1		credit with a grade	
Part time studies					
Lecture	9	1	II	credit with a grade	
Project	9	1		credit with a grade	

SUBJECT OBJECTIVE:

The objective of the course is to broaden the knowledge of structural stability, and in particular to fully understand methods of checking limit buckling states tested during the design of engineering structures.

INITIAL REQUIREMENTS

Strength of materials, structural mechanics.

SUBJECT SCOPE:

Lecture

The concept of loss of stability. Basic stability criteria. The static method, energy method and dynamic method for determining the critical load. Critical points: static bifurcation point, unstable bifurcation point, boundary point. The influence of load and geometry imperfections on stability. Flexural stability, torsional stability, flexural-torsional stability of bar elements. Lateral torsional buckling of bent elements. Stability of compressed slabs and stability of sheared slabs. Shell stability. Initial stability and nonlinear stability. Taking into account geometric non-linearity and physical non-linearity. Non-conservative problems. Stability and the theory of the second order. Structural stability in terms of standard regulations: metal structures, wooden structures, reinforced concrete structures. Application of commercial software to determine critical loads.

Project

An analytical solution to the stability problem of a discrete system with one degree of freedom. Application of the Timoshenko energy criterion for determining the critical load of compressed bars (analytical solution with the use of MathCAD). Application of the Timoshenko energy criterion for determining the critical stress of compression slabs. Verification of the solution using commercial software (Robot, Cosmos / M).

Educational methods:

Lecture - *conventional lecture,*
*Pro*ject - individual and team work on projects based on the teachers explanations.

EDUCATION RESULTS:

Results after completion of the course	Symbol	Verification methods	Type of class
Knowledge			
Complete knowledge of the phenomenon of loss of structural stability and the consequences of its occurrence. Awareness of additional threats resulting from the presence of geometrical and stress imperfections	**K_W01 K_W03**	Test with points	L
Abilities			
Ability to practically apply the rules of structural stability with particular emphasis on the Timoshenko energy criterion. Ability to determine critical loads in bar, slab and shell structures, conscious use of standards concerning the stability of metal, reinforced concrete and wooden structures. Ability to use particular software for symbolic transformations.	**K_U04 K_U09**	Test of abilities	C
Social skills			
The student can think and act logically and independently, work in a team, search for information needed to solve tasks in building standards, literature and on the internet.	**K_K03 K_K04**	conversation during lectures initiated by the teacher; checking skills during the introduction to classes	L , P

REQUIREMENTS TO OBTAIN A CREDIT:

Lecture — Credit based on a test with points:

50% - 60% positive answers	satisfactory,
61% - 70%	satisfactory plus,
71% - 80%	good,
81% - 90%	good plus,
91% - 100%	very good.

Project — The condition for a credit is a positive grade for all projects (3 projects).

Credit for the subject:

The final grade is the average of the grades G = 0.4L+0.6C

STUDENT WORK:

Interaction with the teacher	15w+15p +1cons, total	31 h.
Preparation for tests		11 h
Projects – individual work	3proj x 6h	18 h.
Total	31+11+18	.60 h
ECTS for the subject	60/30	3 ECTS.

BASIC LITERATURE:

1. Timoszenko S. K., Gere J. M., Teoria stateczności sprężystej. Wydawnictwo Arkady, 1963.

2. Ziegler H., Principles of structural stability, Blaisdell Publishing Company, Waltham, 1968.
3. Gerard G., Introduction to structural stability theory, McGraw-Hill Book Company, Inc. New York 1962.
4. Thompson J. M. T., Hunt G. W., A general theory of elastic stability, John Wiley&Sons, London, 1973.
5. Naleszkiewicz J., Zagadnienia stateczności sprężystej, PWN Warszawa, 1958.
6. Bleich F., Buckling strength of metal structures, McGraw-Hill Book Company, Inc. New York, 1952.
7. Galambos, T. V., Guide to Stability Design Criteria for Metal Structures, John Wiley, New York, 1988.
8. Brush, D. O. and Almroth, B. O., Buckling of Bars, Plates and Shell, McGraw Hill-Kogakusha, Tokyo, 1975.
9. Britvec S. J., The stability of elastic systems, Pergamon Press Inc., New York, 1973.
10. Brezina W., Stateczność prętów konstrukcji metalowych, Arkady, Warszawa, 1996.
11. Dym C. L., Stability theory and its applications to structural mechanics, Norrdhoff International Publishing, Leyden, 1974.
12. Huseyin K., Multiple parameter stability theory and its applications, Oxford University Press, New York, 1986.
13. Huseyin, K., Nonlinear Theory of Elastic Stability, Noordhoff Int., Leyden, 1975.
14. Pignataro M., Rizzi N., Luongo A., Stability, bifurcation and postcritical behaviour of elastic structures, Elsevier, Amsterdam, 1991.
15. Simitses G. J., An introduction to the elastic stability of structures, Prentice-Hall Inc., Englewood Cliffs, 1976.
16. Weiss S., Giżejowski M., Stateczność konstrukcji metalowych. Układy prętowe. Arkady, Warsaw, 1991.
17. PN-90/B-03200. Konstrukcje stalowe. Obliczenia statyczne i projektowanie.

ADDITIONAL LITERATURE:

1. Wolmir A. S., Ustojcziwost dieformurijemych sistiem (po rosyjsku), Nauka, Moscow, 1992.
2. Ałfutow N. A., Osnowy razszczeta na ustojcziwost uprugich sistiem (in Russian), Maszinostrojenije, Moscow 1978.
3. Esslinger M., Geier B., Postbuckling behavior of structures, Springer Verlag, Wien, 1975.
4. Marcinowski J., Nieliniowa stateczność powłok sprężystych, Wydawnictwa Politechniki Wrocławskiej, Wrocław, 2000.
5. Simitses, G., Dynamic Stability of Suddenly Loaded Structures, Springer-Verlag, New York, 1990.
6. Waszczyszyn, Z., Cichoń, C., Radwańska, M., Stability of Structures by Finite Element Methods, Elsevier, Amsterdam, 1994.
7. Thompson J. M. T., Hunt G. W., Instabilties and catastrophes in Science and Engineering, John Wiley&Sons, Chichester, 1982.
8. Romanów F., Stricker L., Teisseyre J., Stateczność konstrukcji przekładkowych, Wydawnictwa Politechniki Wrocławskiej, Wrocław, 1972.

SYLLABUS PREPARED BY:

Prof. Jakub Marcinowski, D.Sc. Eng.