COURSE DESCRIPTION CARD - SYLLABUS

Course name
Structural mechanics [S1BZ1E>MB2]

Course

Field of study
Sustainable Building Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
15

Number of credit points

3,00

Coordinators

prof. dr hab. inż. Przemysław Litewka
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Lecturers

Prerequisites

Student has the basic knowledge in: mathematics, foundations of mechanics, strength of materials in the scope from the current course, as well as the structural mechanics from the 3rd semester Student can use the possessed knowledge and gain new abilities from accessible literature. Student can apply the known theory to solve practical problems Student is aware of necessity to expand knowledge so that he can find the justification for its application to practical problems. Student undestands the necessity of constant education.

Course objective

Solution of frames using the classical version of stiffness method and beams - in the classical and matrix versions. Calculation of critical loading for elastic frames. Fundamental knowledge in structural dynamics, computation of natural frequencies and dynamic coefficients.

Course-related learning outcomes

Knowledge:
1. Student knows the relations between displacements and loading in statics, stablility and dynamics of straight beams

2. Student knows the methods to build computational models for structures with concentrated masses
3. Student knows the influence of the large axial forces on plane bar structures.

Skills:
1. Student can find the distributions of internal forces and compute displacements due to external loading, temperature change and imposed displacements in plane bar structures.
2. Student can formulate equilibrium conditions for plane frames according to second order theory and can compute the critical loading.
3. Student can compute natural frequencies and amplitudes of harmonically forced vibrations for bar structures with concentrated masses

Social competences:
1. Student can work individually and in a team
2. Student has the responsibility for the correctness of the obtained solutions and can give their interpretation
3. Student has the consciousness fo necessity of continuous expansion of knowledge.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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1) lecture
written examintation (2.5h) - the mark yields from the total sum of points obtained - 50% for positive mark (3.0)
2) tutorial - 2 test during the semester
3) projects - 2 individual projects for each student - individual consultations, the marks based on the current verification of knowledge at the submission date

Programme content

Lecture
Slope-deflection formulae for straight beams (2h)
Kinematically indetermnate systems - stiffness method (2h)
Matrix version of stiffness method for beams (2h)
Dynamics of systems with concentrated masses. System with 1 degree of freedom. Free and forced vibrations - undamped and damped (2h)
Dynamics of systems with distributed mass - undamped vibrations (2h)
Influence of large axial forces on bending of beams. Initial stability of frames. Examples (4h)
Tutorials
Stiffness method - non-sway and sway frames - external loading and imposed displacements (6h)
Matrix version of stiffness method for beams (2h)
Free and harmonic forced vibrations of frames with concentrated masses (4h)
Exercises (projects)
1.Classical and matrix stiffness method
2. Dynamics of bar structures with concentrated masses - free and harmonically forced undamped vibrations

Course topics

Derivation of slope-deflection formulae
Plane frame kinematically indeterminate - stiffness method
Computation of internal forces in plane frames using the stiffness method - action of forces and support displacements
Structural dynamics - free and forced vibrations with and without damping - illustration of main phenomena for the system with on dynamic degree of freedom
Dynamics of plane beams and frames with discrete mass model - undamped vibrations
Dynamics of beams with distributed mass - natural frequencies, slope-deflection formulae
Second order theory - influence of large axial forces, critical loading, slope-deflection formulae - analysis of stability loss for beams and plane frames.

Teaching methods

Lecture - monographic lecture, tutorials, exercices - exercise and project method

Bibliography

Basic
1. Electronic textbook http://www.ikb.poznan.pl/przemyslaw.litewka/str-me-w.html
2. M. Guminiak, J. Rakowski, Zbiór zadań z mechaniki budowli, Wydawnictwo PWSZ, Piła 2008
3. M. Guminiak, J. Rakowski, Mechanika budowli. Zbiór zadań z elementami ujęcia komputerowego, Wydawnictwo PWSZ, Piła 2011
4. Z. Cywiński, Mechanika budowli w zadaniach (t.I+II), PWN, Warszawa 1976
5. J. Rakowski, Mechanika budowli, Zadania cz.1, Wydawnictwo PP, Poznań 2007
Additional
1. Internet textbook, Mechanika budowli, www.ikb.put.poznan.pl/node/49
2. W. Nowacki, Mechanika budowli, PWN, Warszawa 1974
3. Z. Dyląg i in., Mechanika budowli (t.I+II), PWN, Warszawa 1989

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4,00
Classes requiring direct contact with the teacher	50	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,00