Tadeusz Kosciuszko Cracow University of Technology

Course Card

Faculty of Civil Engineering

Field of study: Civil Engineering

Study profile: general academic

Study form: full-time

Field of study code: BUD

Study cycle: 1st

Specialty: no specialty

1 COURSE INFORMATION

Course name	Mechanika budowli
Course name in English	Structural Mechanics
Course code	WIL BUD oIS C33 24/25
Course category	Basic
No. of ECTS points	10.00
Semester	4 and 5

2 CLASS TYPE, NUMBER OF HOURS ACCORDING TO THE STUDY PLAN

Semester	Lecture	Class exercise	Laboratory	Computer lab	Design exercise	Seminar
4	15	15	0	0	30	0
5	15	15	15	0	15	0

3 COURSE OBJECTIVES

Objective 1 Knowledge of the rules concerning determination of influence lines in statically determinate bar structures. Knowledge of the fundamental theorems of mechanics and their applications. Knowledge of the rules of kinematic analysis of structures.

Objective 2 Knowledge of the rules and procedures concerning the Force Method applied for flat rod statically indeterminate structures.

Objective 3 Knowledge of the rules and procedures concerning solving flat rod statically indeterminate structures using the Displacement Method.

Objective 4 Knowledge of the rules and procedures concerning solving of the buckling problem in the case of flat rod structures.

Objective 5 Knowledge of the rules and procedures concerning determination of dynamic characteristics in the case of flat rod structures with limited number of dynamic degrees of freedom, preparing student for scientific work

Objective 6 Knowledge of the approach to the problem of dynamic actions on rod structures using dynamic coefficient.

4 PREREQUISITES IN TERMS OF KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1 Credited first semester of the subject: Strength of Materials

5 LEARNING OUTCOMES

LO1 Knowledge Student knows the rules of determination of influence lines in the case of statically determinate bar structures. Student knows fundamental theorems of mechanics. Student knows the rules of kinematic analysis of flat bar structures.

LO2 Skills Student is able to determine influence lines in the case of statically determinate bar structures and is able to use them to determine the most disadvantageous positioning of variable loads. Student is able to use theorems for determination of displacements and influence lines in the case of bar structures. Student is able to differentiate correctly if a bar structure is statically determinate or indeterminate or if it is a mechanism.

LO3 Knowledge Student knows the rules and procedures of solving flat rod statically indeterminate structures using the Force Method.

LO4 Skills Student is able to solve flat rod statically indeterminate structures using the Force Method, he is able to verify the results of calculations, he is able to present the physical interpretation of the system of equations of the Force Method and of the values represented in these equations. Student is able to use the Force Method to determine influence lines in statically indeterminate bar structures.

LO5 Skills Student knows the rules and the procedures of solving flat rod statically indeterminate structures using the Displacement Method.

LO6 Knowledge Student is able to solve flat rod statically indeterminate structures using the Displacement Method, he is able to verify the results of calculations, he is able to present the physical interpretation of the system of equations of the Displacement Method and of the values represented in these equations.

LO7 Skills Student knows the rules concerning the application of the Displacement Method to the problem of buckling of flat rod structures.

LO8 Knowledge Student is able to determine values of basic critical buckling loads and buckling modes of flat rod structures.

LO9 Skills Student knows the rules and the procedures of determining dynamic characteristics of flat rod structures with limited number of dynamic degrees of freedom. Student knows the concept of dynamic coefficient and understands the influence of damping on the value of this coefficient under the action of harmonic load. Student is prepared for scientific work.

LO10 Knowledge Student is able to determine free vibration frequencies and corresponding with them free vibration forms, he is also able to verify the obtained results using approximate formulas for calculating first natural frequency of a structure and also using the rule of orthogonality of free vibration forms. Student is

able to apply dynamic coefficient to determine equivalent static action in the case of harmonic load. Student is able to define the influence of damping on the value of the dynamic coefficient and is able to interpret the dynamic coefficients used in polish design codes.

6 COURSE CONTENT

Lecture		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
L1	Introduction to structural mechanics (assumptions, tasks and tools of structural mechanics). Basic theorems of structural mechanics (theorems of reciprocal work, reciprocal displacements, reciprocal reactions). Calculating displacements.	4
L2	Kinematic analysis of flat rod structures. Unstable, statically determinate and statically indeterminate systems.	2
L3	Using the Force Method for solving flat rod statically indeterminate systems. Set of equations of the Force Method. Simplifications. The rules of verification of the final results. Application of the Force Method for determination of the influence lines in statically indeterminate bar structures.	8
L4	Application of the Displacement Method for solving flat rod statically indeterminate systems. Set of equations of the Displacement Method. Simplifications. The rules of verification of the final results. Application of the Displacement Method for determination of the influence lines in statically indeterminate bar structures.	7
L5	Stability of flat rod structures, determination of basic critical buckling loads and buckling modes, second order influences.	3
L6	Dynamics of rod systems, basic assumptions, dynamic characteristics of structures with limited number of dynamic degrees of freedom.	3
L7	Vibration damping, describing parameters, gaining information about the values of this parameters.	1
L8	Application of the dynamic coefficient as a simplified method of taking into account a dynamic action.	2

Laboratory		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
L1	Experimental determination of displacements in a beam. Comparison with calculation results.	2
L2	Experimental determination of reactions in a statically indeterminate beam. Comparison with calculation results.	3
L3	Wind tunnel and its application in the investigations of wind action on structures.	3

Laboratory		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
L4	Apparatus for dynamic measurements and its applications.	2
L5	Experimental determination of free vibration frequencies and corresponding with them free vibration forms in a case of a rod system. Comparison with calculation results.	3
L6	Influence of communication vibrations on structures: measurements and analysis of the measurements results.	2

Design exercise		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
P1	Determination of influence lines of appointed static values in statically determinate rod structures. Determination the most unfavorable position of a variable load and the value of the appointed static value. Calculating displacements in chosen points of a statically determinate rod structure.	10
P2	Solving a continuous beam and a statically indeterminate frame using the Force Method. Giving the result of check of the solution.	12
P3	Determination of influence lines in statically indeterminate continuous beam. Verification of the results using kinematic method.	6
P4	Solving a continuous beam and a statically indeterminate frame using the Displacement Method. Giving the result of check of the solution.	8
P5	Determination of basic critical buckling load and buckling mode for a rod structure.	5
P6	Calculating free vibration frequencies and corresponding with them free vibration forms of flat rod structure with limited number of dynamic degrees of freedom. Verification - using approximate formulas the value of the first natural frequency. Checking the rule of orthogonality of free vibration forms.	4

Class exercise		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
C1	Influence lines of static values in statically determinate rod structures.	2
C2	Calculating displacements in statically determinate rod structures, graphic integration.	2
C3	Solving flat rod statically indeterminate systems using the Force Method, simplifications, verification of results.	8

Class exercise		
No.	Subject matter of the course Detailed description of thematic blocks	No. of class hours
C4	Application of the Force Method for determination of the influence lines in statically indeterminate flat rod structures. Verification of the results using kinematic method.	2
C5	Solving flat rod statically indeterminate systems using the Displacement Method, simplifications, verification of results.	7
C6	Application of the Displacement Method for solving the problem of stability of flat rod structures, determination of basic critical buckling loads and buckling modes.	4
C7	Determining dynamic characteristics of flat rod structures with limited number of dynamic degrees of freedom. Calculating free vibration frequencies and corresponding with them free vibration forms. Application of approximate formulas for calculating first natural frequency. The rule of orthogonality of free vibration forms.	4
C8	Application of dynamic coefficient to determine equivalent static action.	1

7 TEACHING TOOLS

N1 Lectures

N2 Classes

N3 Projects

N4 Laboratory classes

N5 Colloquium

N6 Consultations

8 Student workload

Activity form	Number of hours of activity
Hours realized in contact with the teacher	
Hours resulting from the study plan	120
Consultation hours	5
Exams and tests during session	5
Hours of autonomous student work	
Preparing for classes, studying literature	70
Developing results	30
Preparing of reports, projects presentations, discussion	70
Total number of hours devoted to the subject	**300**
Total number of ECTS points	10.00

9 Methods of grading

Partial grades

F1 Individual project

F2 Report on laboratory classes

F3 Colloquium

Summary grade

P1 Written exam

P2 Weighted average of forming grades

Conditions for passing the course

L1 Completing all learning outcomes

L2 The final grade is an average weighting of the P1 and P2 grades, but none of the component grades can be negative.