COURSE DESCRIPTION CARD - SYLLABUS

Course name
Structural Fire Engineering

Course

Field of study
Civil Engineering
Area of study (specialization)
Structural Engineering
Level of study
Second-cycle studies
Form of study
full- time

Year/Semester
1/2
Profile of study
general academic
Course offered in
Polish
Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	**Projects/seminars**	
30	0	

Number of credit
3

Lecturers

Reasponsible for the course/lecturer:
dr hab. inż Adam Glema, prof. nadzw.
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Responsible for the course/lecturer:
dr inż. Michał Malendowski
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mgr inż. Wojciech Szymkuć
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Prerequisites

Student has knowledge of mathematics and physics, engineering mechanics and strength of materials that is useful for the formulation, modeling materials and solving problems related to the construction and development of the overall design; knows the theory of design and analysis of rod systems in statics, dynamic.

Student is able to perform static analysis, linear stability and bearing capacity of the evaluation of critical states and limit load design for simple bar systems statically determinate and indeterminate; uses information technology, Internet and other sources to search for information, communication and software acquisition to support the work of the designer.

Student draws conclusions and describes the results of its own is aware of the necessity to advance professional and personal competencies.

Course objective

Knowledge on properties and behavior of the structural material according to shorter and longterm time effects, the temperature elevation and other physical influences.

Skills of design calculation and dimensioning, analysis and design of structures and its components, taking into account the phenomena and processes in finite dimensions of space and time, preparation of individual and team design exercise.

- **Course-related learning outcomes**
  Knowledge
- Student has knowledge of the theory of materials, modeling materials
- Students knows advanced topics in strength of materials, construction and building

Skills

- able to conduct a hazard analysis in the implementation and operation of buildings and implement appropriate measures and safety
- able to recognize the evaluation of the quality of materials used and the strength of the elements of buildings
- is able, according to scientific principles using scientific workshop to formulate and carry out preliminary work on a research to resolve the structural problems

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

CREDIT LECTURES written part and network test form in LSM system

Project tasks:

Task 0 Moodle preliminary tasks Setting up a personal profile Moodle 0-10 points.

Task 1 Rheological and viscous properties of building materials. [personal project]

or Definition of the wave. Wave equation. Types and characteristics of the waves. Speed and the propagation time of the wave front, stress, thermal, acoustic and pressure of the air, water, soil, steel, concrete and wood. [personal project] 0-20 points.

TEST 0-10 points.

Task 3 Project : Tensile strength of the material at elevated temperatures. Dimensioning of steel beams in fire. [personal project] 0-30 points.

Task 4 Project : Tensile strength of the material at elevated temperatures. Dimensioning of composite column in fire. [personal project] 0-30 points.

Activity during course and realization of tasks.

TOTAL max 100 points PASS >= 51 Points

The extra term III

CREDIT LECTURES written part: max. test: 15 questions x 7 points = 105 points the oral part:

Project tasks:

Task 0 Moodle preliminary tasks Setting up a personal profile Moodle 0-10 points.

Task 2.2 Rheological and viscous properties of building materials. [personal project] 0-20 points.

Task 3.3 Definition of the wave. Wave equation. Types and characteristics of the waves. Speed and the propagation time of the wave front, stress, thermal, acoustic and pressure of the air, water, soil, steel, concrete and wood. [personal project]

TEST 0-10 points.

Task 4 Project 2 Tensile strength of the material at elevated temperatures. Dimensioning of steel beams in fire. [personal project] 0-30 points.

Task 5 Project 3 Tensile strength of the material at elevated temperatures. Dimensioning of composite column in fire. [personal project] 0-30 points.

TOTAL max 100 points PASS >= 51 Points

Programme content

Introduction. Content and scope of the course. The scope and timing of exercise projects. The method of evaluation. Literature. Behavior of the structural material according to the time, the temperature, the pressure, the strain rate, frequency. Space scales and dimension ranges for structural behavior description. Time scales and ranges for structural behavior description. Long term phenomena and properties of structural material. Rheological and viscous properties of building materials. Historical view on formation and development of rheology. Results of experimental investigation in rheology. Creep test. Relaxation test. Mathematical models of

rheological materials. Calculation of creep and shrinkage in the concrete beam. Short term phenomena in structural materials. Waves and wave effects. Harmonic motion of discrete systems. Derivation of the wave equation as an example strings. Wave propagation speed in structural materials. Dispersion. Constitutive viscosity in dynamic and impact deformations. Material defects. Defects detection. Wave effects in detection of defects. Defectoscope, measurement set, initiation and performance of defect test. Testing of steel elements and welds. Detection of defects and verification of properties in concrete specimen or element. Strength of the material at elevated temperatures. Phenomenon of fire in building. Methods of analysis of fire development. Fire modeling for structural analysis. Mechanical and thermal properties of metals in elevated temperatures. Strength and deformation of steel structure in fire. Design and dimensioning of steel structural elements. Fire resistance of steel structural element in fire. Mechanical and thermal properties of concrete in elevated temperatures. Behavior of concrete or composite element in fire. Design and dimensioning of concrete and composite structural elements in fire. Computer simulation of fire phenomenon and computer aided design of structure in fire. Summary of the course an final evaluation test.

Teaching methods

Lecture supported by multimedia presentation.
Classes and laboratories - example problems supported by multimedia presentations with explanation of problems by teacher using blackboard, solution of individual and team projects.

Bibliography

Basic

M. Chrzanowski, P. Latus, Reologia ciał stałych, Wydawnictwo PK, Kraków, 2001.

Mariusz Maślak, Trwałość pożarowa stalowych konstrukcji prętowych, Wydawnictwo Politechniki Krakowskiej, Kraków, 2008

Kosiorek, J. A. Pogorzelski, and Z. Laskowska, Odporność ogniowa konstrukcji budowlanych. Warszawa: Arkady, 1988.

EN 1990, EN 1991-1-2, EN 1992-1-2, EN 1993-1-2, EN 1994-1-1, EN 1994-1-2

Additional

J.M. Franssen and P. Vila Real, Fire Design of Steel Structures , First edit. Ernst&Sohn, 2010.

A.H. Buchanan, A.K. Abu, Structural design for fire safety, Wiley 2017

A. Bodnar, M. Chrzanowski, P. Latus, Reologia konstrukcji prętowych, Wydawnictwo PK, 2006.

F.C. Crawford, Fale, Wydawnictwo Naukowe PWN, 1973

K. Zieliński, Podstawy Technologii Betonu, Wydawnictwa PP, 2010.

EN 1990, EN 1991-1-2, EN 1992-1-2, EN 1993-1-2, EN 1994-1-1, EN 1994-1-2

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)	30	1,0