COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechanical Structures [S1IŚrod2>KM]

Course

Field of study
Environmental Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
15

Number of credit points

4,00

Coordinators

dr inż. Tomasz Kaźmierski
tomasz.kazmierski@put.poznan.pl

Lecturers

Prerequisites

1. Knowledge: Knowledge of selected topics in mathematics, physics, engineering mechanics, materials strength and thermodynamics. 2. Skills: Use the knowledge to explain processes and phenomena in mechanical and flow devices. 3. Social competencies: Awareness of the need to constantly update and supplement knowledge and skills. Able to share their skills with people in the group.

Course objective

1. Purchase by the students skills of resolving basic problems of mechanical strength in mechanical constructions. 2. Getting to know with flow devices used in water supply, sewage system, heating, ventilation and air conditioning.

Course-related learning outcomes

Knowledge:
1. Basic rules of calculation and selection of the most commonly used machine connections.
2. Types, principles and functions of valves used for cold and hot water.
3. Types, principles of operation, methods of selection and adjustment of pumps used for cold and hot water.

4. Types, principles and ways to adjust the fan in the ventilation and air conditioning.

Skills:
1. Designing simple steel structures based on strength calculations.
2. Selection of centrifugal pumps based on calculations for a specific cold and hot water system.
3. Selection of the right type of fan for the ventilation and air-conditioning system.

Social competences:
1. The student sees the need to systematically deepen and expand their competences.
2. The student understands the need for teamwork in solving theoretical and practical problems.
3. The student is aware of the consequences of exceeding his competence when making decisions.
4. The student understands the need for consultation with experts.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - A final test covering all the topics covered in the lectures. To pass, you must get 50% max. number of points.
Auditorium exercises: Colloquium of tasks
Design exercises: Execution of two projects:
Pipe support
Water pumping station
The final grade as the arithmetic mean of the two component grades.
Each project is assessed on the basis of the following criteria: correctness of assumptions and calculation methods, correctness of calculations and drawings, editorial page of the study, student's involvement.

Programme content

Lectures
Types of loads. Inseparable connections. Fittings and their functions. Valve classification. Stop valves. Gate valves. Check valves. Control valves. Radiator valves. Safety valves. Pump division, operating parameters. Pumping system. Single-stream and double-stream centrifugal pumps: structure, principle of operation, pump drive. Characteristics of centrifugal pumps, pump shell diagram. Cooperation of pumps in parallel and series. Pump performance regulation. Fans, blowers. Fan division. Methods of regulating axial fans.

Course topics

Types of loads. Real and allowable stresses. Fatigue strength. Classification of machine connections. Non-detachable connections: welded, riveted and detachable connections - bolted. Armature and its functions. Functions of valves as a whole and its basic elements. Classification of valves based on functionality and design criteria. Stop valves - requirements, application, strength calculations of the body and spindle. Gate valves - functions, types of valves and their characteristics, rotary valves (taps) - types and construction, non-return valves - requirements, types. Control valves - construction and principle of operation. Flow coefficients - Kv, Kvs, Kv100. Radiator valves with a thermostatic head - principle of operation, throttling criterion, application. Safety valves - functions, classification, characteristics of valve operation. Division of pumps, pump operating parameters - capacity, head, shaft power, efficiency. Pumping system - geometrical and energetic values. Cavitation in pump systems. Single-stream and double-stream centrifugal pumps: construction, principle of operation, pump drive. Characteristics of centrifugal pumps, shell diagram of pumps. Pump operating point, pump applicability field, summary charts. Cooperation of pumps in a parallel and series system. Adjustment of pump capacity. Fans, blowers - characteristics of devices, characteristic values. Fans division. Characteristics of centrifugal fans at constant speed and variable operating conditions. Axial fans - construction, speed and pressure distribution, drive power. Ways of regulating axial fans.

Exercises
Calculations of forces prevailing in truss bars - force polygon method, Ritter, Cremona
Calculations of bleeder, throttle and pump speed control.

Projects

Design of a supporting structure for the pipeline
Design of a water supply pumping station

Teaching methods

Lecture - a lecture with the use of multimedia presentations with elements of a seminar and problem lecture
Auditorium exercises - practice method supplemented with an illustrative case study and a classic lecture (with multimedia presentations)
Project exercises - project method supplemented with a lecture with the use of multimedia presentations

Bibliography

Basic:
1. Janiak M.: Urządzenia mechaniczne w inżynierii środowiska. Cz.1. Wydawnictwo Politechniki Poznańskiej 1993.
2. Janiak M., Krzyżaniak G.: Urządzenia mechaniczne w inżynierii środowiska. Cz. 2. Wydawnictwo Politechniki Poznańskiej 1995.
3. Praca zbiorowa: Mały Poradnik Mechanika tom I i II. Warszawa 1998.

Additional:
1. Stępniewski : Pompy. PWN Warszawa 1985.
2. Świtalski P. ABC techniki pompowej. Wyd. ZPBiP CEDOS Sp. z o.o. Wrocław 2008
3. KAŹMIERSKI T.: Pompy wirowe w systemach wodociągowych. // Wodociągi Kanalizacja. 2005, 9, s. 21-24
4. BAGIEŃSKI J., CIEŚLAK M., KAŹMIERSKI T.: Indeks sprawności energetycznej pomp. // Pompy, pompownie. 2007, nr 2, s. 47-48
5. KAŹMIERSKI T.: Armatura systemów wodociągowych i kanalizacyjnych. // Wodociągi Kanalizacja. 2007, 5, s. 68-71
6. KAŹMIERSKI T.: Zasuwy i przepustnice. // Wodociągi Kanalizacja. 2007, 4, s. 48-50

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50