COURSE DESCRIPTION CARD - SYLLABUS

Course name

THE FIRST LAW OF THERMODYNAMICS AND POWER CALCULATION OF TURBOMACHINERY

Course

Proposed by Discipline

Environmental engineering, mining and energy

Year/Semester

II/3, III/5

Type of studies

Doctoral School

Course offered in

English

Form of study

full-time

Requirements

elective

Number of hours

Lecture

4

Tutorials

Projects/seminars

Number of credit points

1

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

Knowledge: mathematics: algebra – multivariable functions, equations and inequalities, plane and space geometry, trigonometry, analytic geometry, equations and systems of equations, differential and integral calculus, ordinary and partial differential equations. Physics: rules of mass conservation, momentum conservation and energy conservation in classical mechanics, statics, kinematics, dynamics of solid body, fluid mechanics, fundamentals of thermodynamics and heat transfer.

Skills: solving of algebraic equations and algebraic equation systems, mathematical formulation of engineering problems, solving of differential equations and their systems , integral calculus.

Social competencies: awareness of the need of permanent updating and improving knowledge and scientific skills.

Course objective

To present the direct and strong relationship between the basic physical law (first law of thermodynamics) and the very practical and important engineering task like calculation of power of the most popular turbomachines.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:
1) general (differential) form of first law of thermodynamics and its applications, properties of working fluids, physical meaning of total enthalpy and technical work of working fluid, laws governing the operation of turbomachinery, derivation of formulas describing theoretical and real power of turbomachinery. [P8S_WG/SzD_W01]

Skills

A PhD student who graduated from doctoral school can:
1) calculate power of pumps, fans, blowers and compressors, calculate power of water, winter, gas and steam turbines. [P8S_UW/SzD_U01]

Social competences

A PhD student who graduated from doctoral school is ready to:
1) acknowledge the importance of knowledge in solving cognitive and practical problems. [P8S_KK/SzD_K03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W01	Final test of the module (knowledge assessment)	4 questions to answer; 5 points for each correct answer; to pass the test at least 50% (10 points) is required
U01	Final test of the module (skills assessment)	2 problem to be solved; 10 points for each correct solution; to pass the test at least 50% (10 points) is required
K03	Oral test (discussion with PhD students)	No quantitative measures

Programme content

1. First law of thermodynamics – general form in differential formulation (heat, internal energy, enthalpy (total, static, dynamic and elevation), technical work, mass flow rate, power).
2. Theoretical power of turbomachines - equations and their derivation (assumptions, working fluids – gasses and liquids, compressibility of working fluids, working machines: pump, fan, blower compressor, engines: water turbine, wind turbine, gas and steam turbines).
3. Real power of flow machinery (sources of energy losses – heat transfer, friction, leaks, coefficient of efficiency).
4. Case study – water power station (technical and environmental data, structure of the station, theoretical power, real power).

Teaching methods

Lecture: multimedia presentation including illustrations and examples.

Bibliography

Basic

1. White F.M., Fluid Mechanics. McGrawHill Book Company. 5th Int. Ed. Boston 2003.

2. Cengel Y.A., BoleS M.A., Thermodynamics. An Engineering Approach. 6 Edition (SI Units), McGraw-Hill Higher Education, 2007.

Additional

1. Munson B.R., Young D.F., Okiishi T.H., Fundamentals of Fluid Mechanics (4rd. Ed.). John Wiley and Sons Inc., New York 2002.

2. Schmidt P., Baker D., Ezekoye O., Howell J., Thermodynamics. An Integrating Learning System. International Edition., John Wiley and Sons, Inc., U S A, 2006).

3. Sonntag R.E., Borgnakke C., Introduction to Engineering Thermodynamics, 2nd Edition, John Wiley and Sons, Inc., USA, 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	15	1.0
Classes requiring direct contact with the teacher	5	0.5
Student's own work (literature studies, preparation for tutorials [1]	10	0.5

[1] delete or add other activities as appropriate