<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">Irreversible Process Thermodynamics</td></tr>
<tr><td>Code</td><td>PMP20C</td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Larisa Zoranić, PhD, Assistant Professor</td><td>Credits (ECTS)</td><td colspan="3">6,0</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="3"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">To familiarize students with:
- The principle of local equilibrium and global nonequilibrium state of systems
- Theory of irreversible processes in the approximation of local equilibrium
- Applying the theory of linear irreversible processes to describe the process of diffusion, thermal conductivity, chemical reactions, viscosity.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">Completed undergraduate study of Engineering Physics or Physics, Matematics and Physics, Physics and informatics.
Knowledge of:
- Thermodynamics of equilibrium processes
- Vector Analysis
- Newton's laws</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Apply conservation laws and carry out an expression for the entropy production.
2. Apply Curie rule for linearly coupled thermodynamics processes.
3. Apply Onsager reciprocity.
4. Apply the principle of causality to response functions.
5. Explain the significance of fluctuation-dissipation theorem.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">(3h) The principle of local equilibrium
(3h) The equation of continuity
(3h) Tensor equation and pressure changes of momentum in the local form
(3h) The density of the internal energy, heat flux and work done by surface forces
(3h) The first law of thermodynamics in the form of local
(3h) The density of the entropy production
(3h) Thermodynamic forces and flows
(3h) Canonical form of entropy production
(6h) Linear irreversible thermodynamics
(3h) Curie rule
(3h) Onsager relations of reciprocity Application Onsager's relations of reciprocity on thermoelectric effects, coupled diffusion fluxes and coupled chemical reactions
(3h) The principle of causality and Kramers-Kronig relations
(3h) Fluctuation- dissipation theorem
(3h) Kubo equation</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia
☐ laboratory
☒ work with mentor
☐ homework assignments</td></tr>
<tr><td>Student responsibilities</td><td colspan="5">Attending all forms of teaching.</td></tr>
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<tr><td>Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>
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<tr><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th></tr>
<tr><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Experimental work</td><td></td></tr>
<tr><td>Oral exam</td><td></td><td>Report</td><td></td><td>Homework assignments</td><td>2</td></tr>
<tr><td>Seminar essay</td><td>3</td><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Tests</td><td></td><td>Practical training</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
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<tr><td>Grading and evaluating student work in class and at the final exam</td><td>The grade is determined on the basis of grades:
- oral presentations
- domestic works.</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>[1] Yaşar Demirel, Nonequilibrium Thermodynamics Transport and Rate Processes in Physical, Chemical and Biological Systems, 2014 Elsevier B.V</td><td>0</td><td></td></tr>
<tr><td>[2] P. Županović: Termodinamika s elementima statističke fizike, Element, Zagreb, 2016.</td><td>0</td><td></td></tr>
<tr><td>[3] D. Kondepudi, I. Prigogine: Modern thermodynamics, from heat engines to dissipative structures JOHN WILEY & SONS Chichester, New York, Weinheim, Brisbane, Toronto, Singapore, 1998.</td><td>0</td><td></td></tr>
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<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>[1] S. Kjelstrup, D Bedeaux : Non-Equilibrium Thermodynamics of Heterogeneous Systems, World Scientific Publishing Co. Pte. Ltd,2008.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>1. Evaluation of results in accordance with the stated learning outcomes.
2. Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
3. Self-evaluation of teachers.
4. Institutional and non-institutional checks.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td></td></tr>
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