UCLouvain

lmapr2691 — Technology of chemical and environmental engineering

2024

5.00 credits	30.0 h + 15.0 h	Q2

Teacher(s)	Luis Alconero Patricia ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 **Contribution of the course to the program repository:** Referring to the learning outcomes of the KIMA degree, the following AAs are targeted: Axis 1: 1.1, 1.2; Axis 2: 2.2, 2.3, 2.4, 2.5; Axis 3: 3.1, 3.2, 3.3; Axis 4: 4.1, 4.2, 4.4; Axis 5: 5.3, 5.5, 5.6; Axis 6: 6.1, 6.2, 6.3. **Course specific learning outcomes** **Technical Learning Outcomes** At the end of this course, the student will be able to: • Calculate the pressure loss in straight and curved tubes. • Classify pumps and compressors. • Choose a type of pump / compressor according to its use. • Calculate and correctly interpret the maximum load height of a pump and the characteristic curve of a pump. • Analyze the characteristic behavior of pumps in series or in parallel. Calculation of discharge heights and discharge rates. • Analyze serial compression. • Derive and use compression models, compute compression power and efficiency, and analyze and calculate the characteristics of multi-stage compression. • Take into account a deviation of the perfect gases and determine the exponents of the gases. • Classify the different types of agitators. • Size the most important agitators. • Classify the different types of heat exchangers. • Size the most important heat exchangers. • Realize the diagram of a process. • Analyze the safety and regulation of a process. • Perform the thermodynamic analysis of the processes. **Cross-Curricular Outcomes:** At the end of this course, the student will be able to: • Contribute, as a team, to the realization of a disciplinary or multidisciplinary project respecting a framed approach. • Use a body of knowledge in basic and polytechnic sciences, to solve disciplined disciplinary problems. • Mobilize scientific and technical knowledge from a variety of sources, including reference books and the web. • Analyze, organize and complete an engineering approach applied to the development of a process that meets a need or a problem, with the analysis of a given physical phenomenon or system. • Demonstrate rigor and critical thinking in their scientific and technical endeavors while being ethical. • Communicate effectively orally and in writing the results of the missions entrusted to him.
Evaluation methods	Exam (theoretical and practical questions). The exam is divided in three parts related to 1) heat exchangers, 2) pump and compressors and 3) exergy analysis. The students need to achieve a minimum of 8/20 in each part to credit the course. The exam and laboratory contributes with a 80% to the final mark. The Aspen exercises contribute with 20% to the final mark. The use of generative AI such as ChatGPT, Consensus, Perplexity, etc. is tolerated for the search for information or clarification of concepts but its use is prohibited for the elaboration of reports or any material which is part of the course evaluation by the teacher. The student must declare on their honor that the AIs were not used.

Teaching methods	This course combines lectures in class, sessions of exercises in class, and exercises of simulation (computer) using Aspen + A laboratory session on heat exchangers is also planned. This course addresses issues related to sustainable development and transition through the following activities: • Sessions dedicated to the role of exergy in determining if a chemical process is sustaible or not. Destruction of exergy will be discussed as a first step in determining sustainability.
Content	Exergy • Introduction to exergy • Importance of exergy in Chemical Engineering • Exergy in reaction and separation Pumps and Compressors • Pumps: Fundamentals • Types of pumps and their specificities • Compressors: Fundamentals • Types of compressors and their specificities. • Multistage compressors and their benefit Heat Exchangers • Conduction, convection. Solutions of conduction in 1D: multi-layer plate, multi-shell pipe, fins on plates and fins on pipes. Electrical analogy and thermal resistance. • Heat transfert coefficients. Laminar flows: case with constant heat flux density at the wall, case with constant wall temperature, thermally developed flow and thermal entry length. Correlations for turbulent flows. • Heat exchangers: co-current, couter-current, cross-current. LMTD (Logarithmic Mean Temperature Difference) method. • Epsilon-NTU (Number of Transfer Units) method Safety and Operation – invited speaker from industry • HAZOP analysis Safety valves - invited speaker from industry Process simulation using ASPEN (practical classes in computer room)
Inline resources	Course notes and/or copies of the slides used in class are provided to students and available on Moodle
Bibliography	For the part on heat exchangers: F. P. Incropera, D. P. Dewitt, T. D. Bergman, A. S. Lavine, « Fundamentals of Heat and Mass Transfer », Sixth edition, 2007. For the part on exergy: I. Dincer, "Exergy: Energy, Environment and Sustainable Development", 2nd Edition, Elsevier, 2012.
Other infos	This course requires basic knowledge of hydrodynamics & transport phenomena, thermodynamics and applied mathematics.
Faculty or entity in charge	FYKI

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemical and Materials Engineering	KIMA2M	5		