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<tr><td colspan="3">Programme of “Reattori chimici”:
“Chemical Reaction Engineering”.
The aim of the course is to understand the principles for the design and operation of chemical reactors.
The topics related to mass and energy balances, reactor sizing, kinetics of gas-solid catalytic reactions, gas-liquid reactors, fluidized bed reactors are dealt with in details, also with the help of laboratory demonstrations.</td></tr>
<tr><td colspan="3">• Code: I0291
• type of course unit: compulsory
• level of course unit (e.g. first, second or third cycle; sub-level if applicable): second cycle
• year of study (if applicable):1rst year, second semester:</td></tr>
<tr><td colspan="3">Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)</td></tr>
<tr><td colspan="3">Teacher: Prof Pier Ugo FOSCOLO (pierugo.foscolo@univaq.it)</td></tr>
<tr><td>1</td><td>Course objectives</td><td>Short description of course objectives and Learning Outcomes explaining how and in which measure the module contributes to the Programme goals and LO.
At the end of the course the students should be able to understand the importance of fluid-dynamics in designing real reactors with major consideration of the influence of mass transfer on the overall kinetics (final conversion and yield) in multiphase reactors.
Simplified approaches will be also considered to take decisions on the modeling choices to finalize the reactor design. Taking advantage of various numerical exercises, the students will be able to apply the concepts acquired to the industrial reactor design.
The students will also gain the ability to evaluate the importance of employing different chemical reactors for the selectivity of the chemical processes, for the energetic efficiency, and for environmental impact.</td></tr>
<tr><td>2</td><td>Course content and Learning outcomes (Dublin descriptors)</td><td>List of Topics:
Homogeneous reactors: definition of the reaction rate – molar conversion – balance equations utilized for reactor sizing – Damkoehler number – ideal reactors, continuous (tubular and stirred tank) and batch in isothermal operating conditions. multiple ideal reactors to model and design real reactors (residence time distribution functions are dealt with in a different course unit) – methodologies for kinetic analysis and evaluation of kinetic parameters – multiple reaction systems: series and parallel reactions, a generalised standard method to evaluate the performance of multiple reactions systems – complex kinetic expressions. Design of non isothermal reacting systems in continuous and batch operating conditions. Runaway exothermic reacting systems and safety measures.
Heterogeneous reactors: mass transfer coupled with chemical kinetics – external mass transfer (resistances in series) and internal diffusion (reaction efficiency and diffusion enhancement concepts). Shrinking core model. Analysis of gas/solid catalytic systems and gas/liquid and gas/liquid/solid reacting systems. Fixed bed reactors.
Elements of fluidization: two phase theory of fluidization – fluidized bed chemical reactor models.
On successful completion of this module, the student should:
- have extensive knowledge of homogeneous and heterogeneous reacting systems
- applying knowledge and understanding to sizing of homogeneous and heterogeneous chemical reactors.
- making informed judgements on process alternative layouts and control policies of chemical reactors
- demonstrate skill in reactor design and ability to operate them,
- demonstrate capacity to continue learning from scientific literature on chemical reaction engineering and related topics.</td></tr>
<tr><td>3</td><td>Prerequisites and learning activities</td><td>To gain the best benefit from the course, the students must possess a basic knowledge in chemical thermodynamics, unit operations, transport phenomena, and applied physical chemistry.</td></tr>
<tr><td>4</td><td>Teaching methods and language</td><td>Lectures, numerical exercises, lab demonstrations, home work, report
Language: normally Italian, English when required by students
Ref. Text books H. Scott Fogler "Elements of Chemical Reaction Engineering" Prentice Hall Int,
Reports purposely prepared and distributed by the teacher</td></tr>
<tr><td>5</td><td>Assessment methods and criteria</td><td>Oral exam, including discussion of a short report prepared by the student on 2 lab demonstrations and 1 reactor sizing numerical exercise</td></tr>
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