

5.00 credits

Q1

Language :	English
Place of the course	Autre site
Prerequisites	A relevant course about introduction to nuclear energy Fundamental of fluid mechanics, heat transfer, thermodynamic
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <ul style="list-style-type: none"> <li>• To learn how to estimate the volumetric heat generation rate in fission reactor cores under normal operation and shutdown conditions</li> <li>• To learn how to analyse the thermal performance of nuclear fuel elements</li> <li>• To learn the basic fluid mechanics of single phase reactor cooling systems</li> <li>• To learn to calculate pressure drop in reactor systems, including tube bundles, and spacer grids</li> <li>• To learn to analyse the heat transfer characteristics of single phase reactor cooling systems</li> <li>• To learn the basic fluid mechanics of two-phase systems, including modelling approaches, flow regime maps, void-quality relations, and pressure drop evaluation</li> <li>1 • To learn the fundamentals of boiling heat transfer, and its implications for reactor design</li> <li>• To calculate and analyze the coolant conditions throughout a reactor loop including the determination of natural convection regime</li> <li>• To learn the fundamentals of core thermal design, e.g. flow rate/pressure drop relation under different conditions (friction dominated/gravity dominated) for the evaluation of cooling performances</li> </ul> <p>In addition of supervised exercises, a mini-project is organized about modelling and computing pressure drop in a boiling channel (different conditions and assumptions may be treated over the years).</p>
Evaluation methods	The final mark is composed of (i) a written exam(80%, closed book)including an exercise and a theoretical part, and (ii) the mini-project(20%).
Teaching methods	<ul style="list-style-type: none"> <li>• 2 t.m.: 40h teaching + seminar and 15h practical works in classroom</li> <li>• SCK.CEN guidance for demonstrations with codes</li> <li>• SCK.CEN + UCL TA for practical works</li> </ul>
Content	<ul style="list-style-type: none"> <li>• Thermal design principles/reactor heat generation</li> <li>• Reminders about single phase transport equations (prerequisite)</li> <li>• Two-phase flow models, transport equations</li> <li>• Thermodynamic (vessels/pressurizer) and power conversion cycle (steam)</li> <li>• Heat transfer analysis in a fuel element</li> <li>• Reminders about single phase fluid mechanics and heat transfer (prerequisite)</li> <li>• Two-phase fluid mechanics and pressure drops</li> <li>• Two-phase heat transfer (pool boiling, flow boiling)</li> <li>• Single heated channel (thermal and flow problems)</li> <li>• Flow loops (steady state natural convection)</li> </ul>
Inline resources	<a href="https://www.sckcen.be/fbnen">https://www.sckcen.be/fbnen</a>

<p>Other infos</p>	<p><b>Yann BARTOSIEWICZ</b> <a href="mailto:yann.bartosiewicz@uclouvain.be">yann.bartosiewicz@uclouvain.be</a></p> <p>Professor at the Université Catholique de Louvain (UCL, Louvain-la-Neuve)</p> <p>Master in Turbulence modeling and Transfer Phenomena, Ecole Nationale Polytechnique de Grenoble, France, 1998.</p> <p>PhD in Mechanical engineering, Université de Sherbrooke, Canada, 2003: Modeling of supersonic plasma jets in non-Local Thermodynamics Equilibrium</p> <p>Research fields: Fluid mechanics, heat transfer, compressible flows, two-phase flows, thermodynamics, computational fluid dynamics</p> <p>Teaching duties in BNEN: Nuclear Thermal Hydraulics</p> <p>Other research activities: scientific leader for UCL in European projects in nuclear thermal-hydraulics:</p> <p>NURESIM: CFD Simulation of instabilities in a stratified two-phase flows relevant to PTS scenario</p> <p>NURISP: Simulation of two-phase choked flows during LOCA: implementation of non-equilibrium models in CATHARE 3</p> <p>THINS: Direct and Large Eddy Simulation (DNS/LES) of convective heat transfer for low Prandtl fluids (Liquid metals)</p> <p>UCL Promotor of other projects in energy</p> <p>Other duties: Member of the CFD group at OECD, Member of the European Nuclear Engineering Network (ENEN)</p>
<p>Faculty or entity in charge</p>	<p>EPL</p>

<b>Programmes containing this learning unit (UE)</b>				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Advanced Master in Nuclear Engineering	<a href="#">GNUC2MC</a>	5		