


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>At the end of this learning unit, the student is able to :</p> <ul style="list-style-type: none"> • To learn how to estimate the volumetric heat generation rate in fission reactor cores under normal operation and shutdown conditions • To learn how to analyse the thermal performance of nuclear fuel elements • To learn the basic fluid mechanics of single phase reactor cooling systems • To learn to calculate pressure drop in reactor systems, including tube bundles, and spacer grids • To learn to analyse the heat transfer characteristics of single phase reactor cooling systems • To learn the basic fluid mechanics of two-phase systems, including modelling approaches, flow regime maps, void-quality relations, and pressure drop evaluation 1 • To learn the fundamentals of boiling heat transfer, and its implications for reactor design • To calculate and analyze the coolant conditions throughout a reactor loop including the determination of natural convection regime • 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 <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"> • 2 t.m.: 40h teaching + seminar and 15h practical works in classroom • SCK.CEN guidance for demonstrations with codes • SCK.CEN + UCL TA for practical works
Content	<ul style="list-style-type: none"> • Thermal design principles/reactor heat generation • Reminders about single phase transport equations (prerequisite) • Two-phase flow models, transport equations • Thermodynamic (vessels/pressurizer) and power conversion cycle (steam) • Heat transfer analysis in a fuel element • Reminders about single phase fluid mechanics and heat transfer (prerequisite) • Two-phase fluid mechanics and pressure drops • Two-phase heat transfer (pool boiling, flow boiling) • Single heated channel (thermal and flow problems) • Flow loops (steady state natural convection)
Inline resources	https://www.sckcen.be/fbnen

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

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Advanced Master in Nuclear Engineering	GNUC2MC	5		
Master [120] in Energy Engineering	NRGY2M	5		