UCLouvain

lbnen2001

2022

Nuclear thermal-hydraulics (Centre d'étude nucléaire-Mol)

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	**At the end of this learning unit, the student is able to :** 1 • 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 • 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 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).
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	• 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	• 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

Other infos	**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 chocked 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)
Faculty or entity in charge	EPL

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Advanced Master in Nuclear Engineering	GNUC2MC	5		🔍