

3.00 credits

Q2

Language :	English
Place of the course	Autre site
Prerequisites	The following BNEN course is a prerequisite <ul style="list-style-type: none"> <li>• Nuclear Materials</li> </ul>
Main themes	<p>The ex cathedra part of the course covers the following main topics:</p> <ul style="list-style-type: none"> <li>* Functional requirements of materials in a nuclear environment (J. Lecomte-Beckers 1 ECTS)                     <ul style="list-style-type: none"> <li>• Nuclear materials: fuel, fuel cladding, moderator/reflector, coolant</li> <li>• Structural materials: reactor internals and vessel, piping, valves</li> </ul> </li> <li>* Advanced treatment of irradiation effects in materials: radiation damage mechanisms at microscopic level (E. van Walle 1 ECTS)</li> <li>* Corrosion problems in nuclear reactors: material behaviour and material requirements, technological aspects and environment-sensitive damage, with emphasis on light water reactors, in general, and steam generators, in particular (W. Bogaerts 1 ECTS)</li> </ul> <p>Some of these topics are further elaborated during seminars and visits to the SCK'CEN laboratories (incl. hot cells) (E. Van Walle)</p> <ul style="list-style-type: none"> <li>* Basic measurements: source strength, neutron flux (activation analysis, neutron counting), neutron spectrum (time of flight methods, unfolding methods), reaction rates</li> <li>* Activity, dose and cross-section measurement</li> <li>* Measurement of neutron transport parameters: stationary methods, pulsed neutron experiments</li> <li>* Measurement of reactivities (and reactivity coefficients): survey, static methods, dynamic measurements, inverse kinetics Statistical fluctuation method: reactor noise, mathematical analysis, applications (Rossi-alpha, sign correlations, zero crossings)</li> </ul>
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <ol style="list-style-type: none"> <li>1 To provide the students with advanced treatment of the corrosion and embrittlement degradation mechanisms of materials in nuclear environments.</li> </ol>
Evaluation methods	Oral examination; written preparation.
Inline resources	<a href="https://www.sckcen.be/fbnen">https://www.sckcen.be/fbnen</a>
Bibliography	<p>The PowerPoint presentations of the lectures are available on the BNEN website.</p> <p>Other useful references:</p> <ul style="list-style-type: none"> <li>• Fontana, M.G., Corrosion Engineering, 3rd Ed., McGraw-Hill, 1986.</li> <li>• Bogaerts, W.F., Active Library on Corrosion (CD-ROM), 2nd Ed., Elsevier, 1998.</li> <li>• Benjamin, M., Nuclear Reactor Materials and Applications, Van Nostrand Reinhold, 1983.</li> <li>• Glasstone, S. &amp; A. Sesonske, Nuclear Reactor Engineering, 4-th Ed, Vol 1, Chapman &amp; Hall, New York, 1994 (Chapter 7: Reactor Materials, pp 406-462).</li> <li>• Cahn, R.W., Haasen, P., Kramer, E.J., Materials Science and Technology, Volume 10 B, Volume editor Frost B.R.T. , Chapters 7-9</li> </ul>
Other infos	<p>This course is part of the Advanced Master programme in nuclear engineering organized by the Belgian Nuclear Higher Education Network (BNEN). BNEN is organised through a consortium of six Belgian universities and the Belgian Nuclear Research Centre, SCK-CEN and takes place at the SCK-CEN in Mol.</p> <p><b>Prof. Jacqueline Lecomte-Beckers</b> ' Université de Liège  <b>Prof. Eric van Walle</b> ' Katholieke Universiteit Leuven  <b>Prof. Walter Bogaerts</b> - Katholieke Universiteit Leuven</p>
Faculty or entity in charge	EPL

<b>Programmes containing this learning unit (UE)</b>				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Advanced Master in Nuclear Engineering	<a href="#">GNUC2MC</a>	3		