UNIVERSITÀ DI PISA

FISICA E MODELLI NUMERICI PER REATTORI NUCLEARI

VALERIO GIUSTI

Academic year	2017/18
Course	INGEGNERIA NUCLEARE
Code	518II
Credits	12

Modules	Area	Type	Hours	Teacher(s)
FISICA DEI REATTORI NUCLEARI	ING-IND/18	LEZIONI	60	VALERIO GIUSTI
MODELLI NUMERICI PER REATTORI NUCLEARI	ING-IND/18	LEZIONI	60	VALERIO GIUSTI

Obiettivi di apprendimento

Conoscenze
The student who successfully completes the course will have the ability to understand the neutron transport phenomena typical of a nuclear reactor core, with reference both to the static and dynamic effects important for the reactor core design. He will be able to demonstrate a solid knowledge of the neutron diffusion and transport theories, particularly as it concerns their application to engineering problems like the determination of the multiplication constant of a reactor core or the calculation of a reactor fuel cell. He will be also aware of the mathematical and numerical tools that are at the basis of the typical reactor core calculations.

Modalità di verifica delle conoscenze
During the oral examination the student will be assessed on his/her demonstrated ability to discuss with rigor the main course contents using the appropriate terminology. It is also expected that he/she will show a good ability in making connection between the different topics of the course.
Methods:

- Final oral exam

Capacità
The student will master the main analytical and numerical tools for the prediction of the behaviour of neutrons in nuclear reactors.

Modalità di verifica delle capacità
Oral Examination with proposal of problems.

Comportamenti
The student will become acquainted with the behaviour of neutrons as the fundamental aspect of any nuclear plant, in terms of power production and energy. The inherent feedbacks, the dynamic and static behaviour should enter into the the DNA of any nuclear engineer as the focus of his / her study.
The matter proposes a fascinating series of topics, strictly linked to the history of nuclear energy (from Fermi and coworkers to the most up to date computational techniques). The student should feel this link to the historical and present developments of this fascinating matter.

Modalità di verifica dei comportamenti
The oral examination will provide sufficient easy to the teacher to assess the mstery that the student has reached in handling the fascinating mathematical and physical concepts and tools offered by the course.

Prerequisiti (conoscenze iniziali)
Physical Principles of Nuclear Engineering. However, the course is conceived for staring from scratch in nuclear matters.

Corequisiti
None.

Indicazioni metodologiche

Delivery: face to face
Learning activities:

- attending lectures
- participation in seminar
- participation in discussions
- Laboratory work

Attendance: Advised

Programma (contenuti dell'insegnamento)

The course covers the following aspects: the continuity equation, the Fick's law and the diffusion equation of the neutrons; steady-state neutron diffusion problems with fixed source; the Green function of the diffusion equation; the neutron slowing down and the resonance absorption; the multiplication constant of a critical reactor with one or more energy groups; the delayed neutrons and the kinetic of a homogeneous reactor core; typical strategies to solve the criticality problems with one or more energy groups; solution of linear algebraic equation systems with direct or iterative methods (Jacobi, Gauss-Seidel, SOR, ADI,...); numerical solution of multigroup neutron kinetics problems with delayed neutrons; the integro-differential transport equation and its spherical harmonics approximation; the integral transport equation and its derivation from the integro-differential form; the collision probability method; the discrete ordinate method; the ray effect.

Bibliografia e materiale didattico

Teaching materials provided by the teacher.
Recommended readings include:

- J.R. Lamarsh, Nuclear Reactor Theory, Addison Wesley Publishing;
- E.E. Lewis, W.F. Miller, Computational Methods of Neutron Transport, Wiley-Interscience Publication;
- G.I. Bell, S. Glasstone, Nuclear Reactor Theory, Van Nostrand Reinhold Company;
- A. Hebert; Applied Reactor Physics, Presses Internationales Polytechnique.

Indicazioni per non frequentanti

Contact Prof. Valerio Giusti at v.giusti@ing.unipi.it for any direction.

Modalità d'esame

Oral examination. It is possible to split the final examination into two parts, the first related to the Reactor Physics module, the second to the module of Numerical models. The two colloquia will be considered tests "in itinere".
The oral test consists of an interview between the candidate the lecturer and, generally, a lecturer's colleague or collaborator. The duration of the oral interview is ranging between one and two hours depending on the quality of it.
To pass the test the candidate has to show the ability of express him/herself in a clear manner using the correct terminology answering the posed questions. If the candidate will show a complete lack of knowledge of one of the different argument discussed during the course, the test will fail.

Stage e tirocini

At the end of the MSc Course, a thesis work in this matter will constitute a great opportunity, also for stages abroad.

Pagina web del corso

https://www.unipi.it/index.php/lauree/corso/10621

Altri riferimenti web

- http://younuclear.ing.unipi.it/
- https://www.facebook.com/NuclearEngineeringPisa/
- https://www.linkedin.com/groups/8463083
- https://www.linkedin.com/groups/4501364

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