



# UNIVERSITÀ DI PISA

## NUCLEAR PLANT STRUCTURAL DESIGN

ROSA LO FRANO

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CdS INGEGNERIA NUCLEARE  
Codice 824II  
CFU 6

Moduli	Settore/i	Tipo	Ore	Docente/i
NUCLEAR PLANT STRUCTURAL DESIGN	ING-IND/19	LEZIONI	60	ROSA LO FRANO

### Obiettivi di apprendimento

#### Conoscenze

The student who successfully completes the course will have the capability to:

- analyze the behaviour and the main functional, structural and safety issues of plants and systems;
- demonstrate a solid and advanced knowledge on the relevant design issues of complex plants;
- interface with/join specialists in different areas;
- understand and apply design and construction techniques, including also the use of FEM and/or system codes generally used to support the design;
- to be aware of rules and regulations regarding the safety of plants and of some plant components;

#### Modalità di verifica delle conoscenze

The student will be assessed on his/her demonstrated ability to discuss the main course contents using the appropriate terminology. During the oral exam the student must be able to demonstrate his/her knowledge of the course material and be able to discuss and develop one or more exercises related to the main topic presented during the course. Students must demonstrate to be able to preliminary design (sizing) systems and components of studied plants and critically discuss the technological solution.

Methods:

- Final oral exam

#### Capacità

The following main skills are provided by the course:

- capability to analyze the behaviour and the main functional, structural and safety issues of plants and systems;
- capability to demonstrate a solid and advanced knowledge on the relevant design issues of industrial and nuclear power plants;
- capability to interface with/join specialists in different areas of the structural design of plant structures;
- understanding and application of design and construction techniques and rules, including also the use of FEM and/or system codes generally used to support the design and the deterministic safety assessment (demand vs. capacity evaluation)

#### Modalità di verifica delle capacità

Oral examination with assignment of typical structural problems and preliminary dimensioning of components and parts of plants of interest for the course.

Students have to demonstrate mastery and innovation, advanced skills, required to solve complex and unpredictable problems in a specialised field of NPP structural integrity

#### Comportamenti

The students are supposed to:

- develop the capacity to analyze the behaviour and the performance of plant/plant systems and structures thoroughly plant lifetime;
- acquire a solid and advanced knowledge on the relevant issues characterising the industrial and nuclear plants



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design, including also the use of FEM and/or system codes;

- be able to critically analyse construction techniques and rules in relation to siting aspects;
- achieve those attitudes typical of design safety design culture; i.e. accountability, open and communicating attitudes, questioning attitudes

### *Modalità di verifica dei comportamenti*

The oral interview will ascertain the personal attitudes by proposing questions and problems related to the dimensioning of components and parts of plants.

### *Prerequisiti (conoscenze iniziali)*

Basic knowledge about the nuclear plants, materials, algebra, mechanics, science and construction technique, QA and safety, and the ability to interpret overall drawings and details.

### *Corequisiti*

No specific suggestion for courses to be attended in parallel

### *Prerequisiti per studi successivi*

No specific suggestion

### *Indicazioni metodologiche*

The course is one of the most interdisciplinary one proposed and consists of lectures (with visual aids such as powerpoints/videos, etc.), exercises and numerical applications (e.g. by using computers in the IT classroom or students' personal computers, etc.) integrated in the classroom together and correlated with theoretical notions presented.

The teaching activity, in relation to the level of preparation reached by the students, can be completed by the autonomous development under the guidance of the teacher, of a simple project in which the concepts acquired will be applied. The course can also be integrated with lectures and seminars of external teachers and experts.

The subdivision of the total working hours foreseen offers the student the possibility to verify and improve his own learning ability also through a synergic interaction between the student and the teacher (e.g. meetings, email or other methods of communication)

Delivery: face to face

Learning activities: attending lectures; participation in seminar and in discussions; individual study and laboratory work

Attendance: Advised

Teaching methods: Lectures; Seminar; Task-based learning/problem-based learning/inquiry-based learning laboratory

### *Programma (contenuti dell'insegnamento)*

The course aims to provide the knowledge and the methodological basis useful to study the complex industrial plants, intended as system and sub-system strongly connected together, whose correct operation may be relevant not only for the operation of the plant but also for the safety of workers and environment.

The contents/main notions deal with:

- Industrial Plants: types of industrial plants in the energy sectors, classification criteria and general equipment
- Criteria and general issues for the design and construction of an industrial complex plant;
- Siting aspects (environmental-plants interaction and design against the external events);
- Plants and SSCs structural integrity;
- Design load criteria & Classification of Load combinations (wind, fire actions, Earthquake and aircraft, etc.)
- Basis and approach for Seismic Design of NPP: dynamic responses of SDOF & MDOF
- Seismic classifications & requirements to determine the dynamic response
- Soil categories and local site influence
- Steel and reinforced concrete structures (materials, process, factors affecting the strength, mechanical behavior of reinforced concrete and the failure mechanism);
- Engineering practical solutions and numerical methods/tools.
- Introduction to foundations: types and design load, design principles and criteria of verification
- Application case will be discussed and analysed by applying numerical codes

### *Bibliografia e materiale didattico*

The recommended reading includes:

- L. Santarella, "Handbook of Reinforced Concrete", 2010, Hoepli Ed.
- EUROCODE and other National and International Guidelines (i.e. NTC2018, ASME, ACI, etc.)
- Teaching materials distributed during the course
- Further bibliography indicated during lessons



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### Indicazioni per non frequentanti

The teaching material, yearly updated will be provided to students by email or making it available on shared folder

The receipt of the students is always available to support students in solving any possible encountered learning problem

### Modalità d'esame

The oral examination, as described above, consists in an oral exam that includes assignment of typical problems and development of one or more exercises related to the theory and a preliminary dimensioning of a component and part of plants.

### Stage e tirocini

The MSc in nuclear engineering mainly suggests stages at the end of the formal educational though examinations, favouring the works performed abroad at renown institutions.

### Note

For exams, contact [rosa.lofrano@ing.unipi.it](mailto:rosa.lofrano@ing.unipi.it)

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