

Course guide

240IEN21 - 240IEN21 - Nuclear Power Plants

Last modified: 16/04/2024

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 748 - FIS - Department of Physics.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Alfredo de Blas

Others: Suarez Cambra, Daniel
Freixa Terradas, Jordi
De Blas Del Hoyo, Alfredo
Calviño Tavares, Francisco

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CEMEI01. Knowledge and ability to analyse and design the generation, transport and distribution systems in electric energy.
CEMEI17. Ability on the design, manufacturing, construction and operation of industrial plants.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

General objective:

To show the technical and safety criteria applied to the design, construction, operation and dismantling of nuclear power plants. The basic aspects concerning the technology of structures, systems and components of an NPP, as well as its management are presented.

Specific objectives:

To present the engineering areas involved in the project, construction and operation of nuclear power plants.

To remark the most important functions of the main structures, systems and components on an NPP.

To remark the importance of the administrative and technical methods used to verify safety in complex energy facilities, like nuclear power plants.

To remark the safety culture concept and the human factor in the operation of nuclear power plants.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours small group	13,5	12.00
Hours large group	27,0	24.00

Total learning time: 112.5 h

CONTENTS

Introduction to nuclear energy. Basic concepts.

Description:

content english

Related activities:

Practical session. Exercises resolution.

Full-or-part-time: 2h 30m

Theory classes: 1h 30m

Practical classes: 1h

Elements of the nuclear reactor.

Description:

Basic elements of a nuclear reactor.

Specific objectives:

To present the basic elements of a nuclear fission reactor as a source of heat and radioactivity.

Full-or-part-time: 1h 30m

Theory classes: 1h 30m

Development of Nuclear Power Plants.

Description:

Description of Generation II technologies (light water reactors, heavy water reactors, gas reactors). Generation III and generation IV technologies.

Specific objectives:**Full-or-part-time:** 3h

Theory classes: 3h

Pressurized water reactors.

Description:

Primary System: Reactor vessel, internals, fuel element and control element, reactor coolant pumps, pressurizer. Secondary System: Steam generator, turbine, generator, condenser, the steam cycle. Tertiary system.

Specific objectives:

To present the technological characteristics of the PWR, the most used among NPPs.

Full-or-part-time: 4h 30m

Theory classes: 4h 30m

Auxiliary systems.

Description:

Description of the main auxiliary systems of a PWR: The chemical and volume control system. The boric acid addition system. Others.

Full-or-part-time: 1h 30m

Theory classes: 1h 30m

Safety systems and containment systems.

Description:

Introduction to the concept of nuclear safety. Description of the main safety systems of a PWR plant.

Full-or-part-time: 1h 30m

Theory classes: 1h 30m

Operation and control of a nuclear power plant.

Description:

Description of the automatic control systems of a PWR. Reactor reactivity feedback and human actions needed to operate a plant. Real operating experiences.

Related activities:

Practical session.

Full-or-part-time: 7h 30m

Theory classes: 6h

Practical classes: 1h 30m

Nuclear Safety.

Description:

Main concepts of nuclear safety. Defense in depth. Safety related design criteria. Descriptions of the main accidents occurred in NPPs. Description of the main thermohydraulic phenomena. DSA. PSA. Emergency Operating Procedures. Introduction to the international organizations.

Related activities:

Practical session

Full-or-part-time: 7h 30m

Theory classes: 6h

Practical classes: 1h 30m



Nuclear fuel cycle.

Description:

Nuclear fuel cycle description. Open and closed cycle. Fuel needs and reload. Management of nuclear waste and dismantling on the plant.

Specific objectives:

To remark the importance of the nuclear fuel resources and the obligations derived from its use (waste management)

Related activities:

Practical exercise session.

Full-or-part-time: 1h 30m

Theory classes: 1h 30m

Radiological Protection.

Description:

Main concepts related to the Radiological Protection.

Full-or-part-time: 1h 30m

Theory classes: 1h 30m

title english

Description:

content english

Full-or-part-time: 10h

Laboratory classes: 10h

GRADING SYSTEM

BIBLIOGRAPHY

Basic:

- Kok, Kenneth D. Nuclear Engineering Handbook. 2nd ed. Boca Raton: CRC Press, 2016. ISBN 9781482215922.

Complementary:

- Shultis, J. Kenneth ; Faw, Richard E. Fundamentals of Nuclear Science and Engineering. 2nd ed. Boca Raton: CRC Press, 2008. ISBN 9781420051353.

RESOURCES

Hyperlink:

- Programa de formación práctica en el área de ingeniería nuclear mediante el simulador conceptual de central nuclear SIREP. E-prints UPC, <http://hdl.handle.net/2117/17190> pag206