Nuclear Energy

Academic Year: (2020 / 2021) **Review date: 09-07-2020**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: VENEGAS BERNAL, MARIA CARMEN

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I, II, III
Physics I, II
Chemical Fundaments of Engineering
Writing and Communication Skills
Programming
Thermal Engineering
Engineering Fluid Mechanics
Heat power plants
Aero-thermochemical Systems

OBJECTIVES

Upon successful completion of this course, students will be able to:
1.- know and understand the scientific principles underlying nuclear energy;
2.- apply their knowledge and understanding to identify, formulate and solve problems related to nuclear energy using established methods;
3.- apply their knowledge and understanding to develop and realise designs of systems or components to meet specified requirements;
4.- conduct searches of literature, and to use data bases and other sources of information;
5.- select and use appropriate equipment, tools and methods;
6.- function effectively as an individual and as a member of a team;
7.- use diverse methods to communicate effectively with the engineering community and with society at large;
8.- demonstrate awareness of the health, safety and legal issues and responsibilities of nuclear energy use, the impact of solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of nuclear energy use.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction
1.1. History of nuclear energy and its contribution to the electric generation in Spain and the world.
1.2. Nuclear physics and radioactivity.
1.3. Kinetics, dynamics and thermohydraulics of the reactor.
2. Thermodynamic cycles and components of nuclear power plants (NPP)
2.1. Types of NPP.
2.2. Thermodynamic cycles of NPP.
2.3. Reactor, turbines, humidity separators, condenser, pumps, feedwater heaters, etc.
3. Fuel and nuclear safety
3.1. Production and cycle of nuclear fuel.
3.2. Control and safety systems of NPP.
4. Radiologic protection and waste management
4.1. Ionizing radiations and measurement systems.
4.2. Equipment and systems for radiologic protection.
4.3. Classification and management of radioactive wastes.
4.4. Dismantling of nuclear power plants. Spanish case.
4.5. Socioeconomics and environmental aspects.
5. Other developments
5.1. Current developments of NPP.

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology includes:
(1) Lectures covering the topics described within the course outline. To facilitate the sessions, the students will have available the lecture's slides as well as reference books to complete their learning.
(2) Solving problem sessions, where some issues are addressed from a practical point of view.
(3) Exercises solved by the student to self-assess their knowledge and to acquire the necessary abilities.
(4) Practical works. Elaboration of reports presenting the results obtained using computer software. The capacity of the students to present and discuss clearly and concisely the results will be evaluated.

ASSESSMENT SYSTEM

ORDINARY CALL:
Continuous evaluation (60% of the final mark) + Final exam (40% of the final mark).
What does the continuous evaluation include?
- 2 partial exams (20% of the final mark each one)
- 3 computer labs (as total, 10% of the final mark). Attendance is compulsory. The reports delivered will be evaluated.
- 1 practical work (10% of the final mark). The report delivered and the oral presentation will be evaluated.

EXTRAORDINARY CALL:
There are 2 options, selecting that of the highest mark:
- Final exam: it represents 100% of the final mark.
- Similarly to the ordinary call: continuous evaluation (60% of the final mark) + final exam (40% of the final mark).

Contents of the partial and final exams:
- Practical problems covering the topics of the program.
- Short theoretical questions.
- Test quizzes.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- Günter Kessler Sustainable and Safe Nuclear Fission Energy. Technology and Safety of Fast and Thermal Nuclear Reactors, Springer, 2012
- Igor L. Pioro Handbook of Generation IV Nuclear Reactors, Elsevier, 2016
- M.D. Carelli, D.T. Ingersoll Handbook of Small Modular Nuclear Reactors, Elsevier, 2015
- MIT The Future of Nuclear Power, Massachusetts Institute of Technology, 2003
- R.E. Masterson Nuclear Engineering Fundamentals: A Practical Perspective, CRC Press, 2017
- Raymond L. Murray Nuclear energy: an introduction to the concepts, systems, and applications of nuclear processes. 6th ed. , Butterworth-Heinemann-Elsevier, 2009