COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2022 - 2023

GENERAL INFORMATION

Data of the subject	
Subject name	Energy Engineering
Subject code	DIM-MII-522
Mainprogram	Official Master´s Degree in Industrial Engineering
Involved programs	Máster Universitario en Ingeniería Industrial [First year]
Level	Postgrado Oficial Master
Quarter	Semestral
Credits	7,5 ECTS
Type	Compulsory
Department	Department of Mechanical Engineering

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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

There are not any prerequisites needed to study the subject. However, as the subject is inserted in an engineering syllabus, it is supported on concepts previously seen in other subjects:

Thermodynamics

- **Energy and mass balances**

Heat transfer

Heat exchangers

Course contents

Contents

Theme 1: Systems

Unit 1: Introduction

1. Energy, classifications and types. Energy sources.
2. Macro-energy units.
3. Environmental implications of power generation.
4. Social and geostrategical aspects of energy sources.
5. Assessment of scenarios and energy policies.
6. Assessment of economic feasibility of energy projects.

Unit 8: Analysis of energy systems in off-design working

1. Introduction.
2. Heat exchangers and ducts.
3. Volumetric machines.
4. Turbomachines.
5. Systems integration.

Theme 2: Energy sources

Unit 2: Combustion

1. Introduction.
2. Combustion reactions.
3. Mass balance.
4. Energy balance.

Unit 6: Nuclear energy

1. Introduction
2. Nuclear reactions.
3. Systems and components of a nuclear reactor.
4. Nuclear fuel cycle.
5. Nuclear wastes.
6. Ionozing radiations.
7. Nuclear fusion.
8. Nuclear power plants: types and Generations
9. Current nuclear power plants: Generation II and III
10. Forthcoming nuclear power plants: Generation III+, IV and fusion

Unit 7: Fossil fuels

1. Introduction
2. Oil and derivatives production and distribution.
3. Natural gas production and distribution.
4. Coal production and distribution.
5. Non-conventional hydrocarbons production.
6. CO2 storage.

Theme 3: Energy conversion

Unit 3: Fossil fuel power plants

1. Introduction.
2. Coal power plants (steam cycle).
3. Combined cycle power plants.
4. Repowering of coal power plants.
5. Clean combustion in power plants.
6. CO2 capture.

Unit 4: Refrigeration cycles and heat pumps

1. Introduction.
2. Low temperature chillers.
3. Advanced heat pumps.
4. Non-conventional chillers.
5. Absorption chillers.

Unit 5: Advanced power plants

1. Introduction.
2. Combined heat and power.
3. Organic Rankine cycles.
4. Supercritical CO2 cycles.
5. Other power plants.
6. Electric generation from renewable sources
7. Massive energy storage.

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Exams Problems or case study	Both the procedure chosen for the resolution of the problem as well as the numerical results, which, although they may be incorrect, must be coherent and logical.	35 %

Exams Qualitative questions	Various concepts presented in the subject will be developed or a critical judgement on a technological solution to a problem will be issued based on the concepts seen in the course.	25 %
Exams Tests questions	The right answer should be identified within a set of options.	10 %
Continuous assessment Laboratory sessions	Attendance is mandatory. The report delivered after session will be scored.	15 %
Continuous assessment Team works	Works will be developed in groups based on teacher proposal. A report will be written, which will be presented tin the classroom.	15 %

Grading

Ordinary summon

The score for the **ordinary summon** will be obtained by:

- 70% comes from the exams. End of term exam score will weight 50% in the overall score of the subject while the score in the mid term exam will weight 20%.
- 15% comes from team work.
- 15% comes from the lab sessions reports.

If the previous weighted average results higher than 5 the subject score will be such average; in the opposite case the score will be the minimum between such average and the end of term exam score.

Final score might be increased up to 0.5 points depending on student participation on the subject Forum. Quantity and quality of the participation will be taken into account. The lack of participation in such Forum will never penalize the score of the subject.

Exraordinary summon

The score for the **extraordinary summon** will be obtained by:

- 20% from the score obtained in continuous evaluation (average between team work and lab reports).
- 80% from the extraordinary summon exam.

If the previous weighted average results higher than 5 the subject score will be such average; in the opposite case the score will be the minimum between such average and the extraordinary summon exam score.

Final score might be increased up to 0.5 points depending on student participation on the subject Forum. Quantity and quality of the participation will be taken into account. The lack of participation in such Forum will never penalize the score of the subject.

Rules

Attendance (see latter) and work team and lab reports performing is a necessary condition to pass the subject in both summons.

Neither programmable calculators nor formulae summary, books and notes are allowed. In the exams a formulae summary covering economic parameters (unit 1) and cogeneration indexes (unit 6, if applicable) will be included. A sample of such summary can be found in past exams available in Moodle.

Attendance: The absence of more than 15% of the total amount of classes can entail to fail the ordinary summon.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
Self-learning of concepts presented in class (slides and additional text if any)	After session	
Problem solving	After the end of the unit	
Mid term and end of term exam	Week 8 and ordinary summon period	
Mid term exam preparation	At least weeks 7 and 8	
End of term exam preparation	At least weeks 13, 14 and 15	
Lab sessions	Weeks 11, 12, 13 and 14	
Lab sessions reports performing		Weeks 12, 13, 14 and 15
Teams work performing	Weeks 3 to 15	M1: week 7; M2: week 11; M3: week 13 to 15
Teams work presentation	Weeks 13 to 115	

BIBLIOGRAPHY AND RESOURCES

Basic References

- Slides of every unit (available at Moodle).
- Additional texts of nearly all the units (available at Moodle).
- Solved problems (available at Moodle).
- Solved exams (available at Moodle).

Additional references

- E. Cassedy and P. Grossman, Introduction to Energy: Resources, Technology and Society. Cambridge University Press, 1998

- R.W. Haywood, Analysis of Engineering Cycles, 4th Edition. Pergamon Press, 1991.