Universidad de Navarra

Termotecnia y Fluidos(Ing.Gr.)
Guía docente 2026-27

PRESENTACIÓN

Breve descripción:

This course is a continuation of the courses *Transferencia de Calor* (Heat Transfer) and *Mecánica de Fluidos* (Fluid Mechanics), and students will broaden their knowledge of thermal-fluid sciences by studying **thermal radiation**, **turbomachinery**, **compressible flow**, and **aerodynamics**.

Titulación (Módulo/Materia):

- Ingeniería Mecánica (Bloque Especializado Mecánica/Tecnología Térmica y Fluidos)

Detalles:

- **ECTS**: 6 ECTS
- **Curso, semestre**: 4.º curso, 2º semestre
- **Carácter**: Obligatorio
- **Idioma**: English

Profesores de la asignatura:

- Aramburu Montenegro, Jorge/Profesor Titular
- Villarón Baz, Juan Ignacio/ Colaborador docente

RESULTADOS DE APRENDIZAJE (Competencias)

INGENIERÍA MECÁNICA

CE20 - Conocimientos y capacidades para el cálculo, diseño y ensayo de máquinas.

CE24 - Conocimiento aplicado de los fundamentos de los sistemas y máquinas fluido-mecánicas.

CG10 - Capacidad de trabajar en un entorno multilingüe y multidisciplinar.

PROGRAMA

Unit 0: Introduction to thermal engineering

- What and how?
- Physical origins and rate equations
- Relationship to Thermodynamics
- Units and dimensions
- Analysis of heat transfer problems: methodology
- Relevance of heat transfer
- Summary

Unit 1: Thermal radiation

- Fundamental concepts
- Radiation heat fluxes
- Radiation intensity
- Blackbody radiation
- Emission from real surfaces
- Absorption, reflection, and transmission by real surfaces
- Kirchhoff's law
- The gray surface

- Environmental radiation

Unit 2: Radiation exchange between surfaces

- The view factor
- Blackbody radiation exchange
- Radiation exchange between opaque, diffuse, and gray surfaces in an enclosure
- Multimode heat transfer
- Implications of the simplifying assumptions

Unit 3: Turbomachinery

- Introduction
- Turbomachinery generalities
- Turbomachinery variables
- Velocity triangles and Euler's equation
- Dimensional analysis and similarity

Unit 4: Compressible flow

- Introduction
- Thermodynamics of compressible flows
- Isentropic flow in ducts (i)
- Shock waves in compressible flows
- Isentropic flow in ducts (ii).

Unit 5: Aerodynamics

- Introduction
- Drag force
- Lift force
- Flow-induced vibrations
- Effects of compressibility

ACTIVIDADES FORMATIVAS

The **dedication of 150-180 hours** (6 ECTS) to the course Termotecnia y Fluidos is distributed in the following educational activities:

- Clases expositivas (AF1): 30 h teóricas + 30 h prácticas.
- Tutorías y atención a dudas (AF6): 3 h.
- Estudio personal (AF5): 80 h.
- Evaluaciones (AF9): 7 h.

METODOLOGÍAS DOCENTES

- Clases expositivas
- Entrevista personal con el profesor de una asignatura
- Realización de pruebas evaluadas

Lectures (*clases expositivas*) include both theoretical sessions and sessions where problems /exercises are solved. All the PowerPoint presentations that the lecturer uses during the lectures and the proposed problems for each unit are in Adi. Students should work on their own according to their ability to learn concepts and the skills needed to successfully fulfill the competences listed in section "Competencias". Additionally, tutorials (*entrevista personal con el profesor de una asignatura*) are available to all students, meaning that students are welcome to approach the lecturer to ask any course-related questions. The mark is calculated with an assessement that consists of all the items that are explained in section "Evaluación"; some of the items include mid-term exams (*realización de prueba evaluadas*).

EVALUACIÓN

CONVOCATORIA ORDINARIA

- **Evaluación de actividades prácticas (SE2)**: 10%.
- **Evaluación de trabajos individuales y/o en equipo (SE4)**: 10%.
- **Evaluaciones parciales y finales (SE1)**: 80%.

The maximum mark a student can get is 10. The mark is distributed as follows:

- Exams: **80%**. Exam 1 (16%), Exam 2 (16%), Exam 3 (16%), Exam 4 (16%), Exam 5 (16%). Exams 1, 2, 3, and 4 are taken during the semester.
- Self-evaluation tests: **10%**. Tests 1-5. These are five tests, one per unit, each accounting for 2%, and are taken a week after a unit has been finished.
- Report: **10%**. A problem is solved and a report is written about the solution of the problem.

In order to pass the course,

- **the overall mark must be greater than or equal to 5/10, AND**
- **the mark in each of the exams (Exam 1, Exam 2, ..., Exam 5) must be greater than or equal to 3/10.**

CONVOCATORIA EXTRAORDINARIA

- **Evaluación de actividades prácticas (SE2)**: 10%.
- **Evaluación de trabajos individuales y/o en equipo (SE4)**: 10%.
- **Evaluaciones parciales y finales (SE1)**: 80%.

Students will have to retake at least all the exams that were not previously passed. An exam is passed when the mark is greater than or equal to 5. If someone decides to retake an exam that was previously passed, the student has to inform the lecturer one week before the retake exam.

In the assessment, two marks will be calculated and the maximum will be the final mark. Mark A: with the same mark distribution as in the regular exam. Grade B: assuming each exam accounts for 20% of the total mark.

For further information on Assessment, please see the Assessment document in Adi.

HORARIOS DE ATENCIÓN

Dr Jorge Aramburu Montenegro (jaramburu@unav.es)

- Despacho IG-104. Edificio Igara. Planta -1
- Horario de tutoría: Students are more than welcome to approach the lecturer to ask any course-related question. Appointments must be arranged by email at jaramburu@unav.es. As a general rule, emails will not be answered on weekends, and questions will not be addressed by email. Furthermore, questions regarding exams will not be answered on the day before the exam.

BIBLIOGRAFÍA

Bibliografía básica:

- F.P. Incropera, D.P. De Witt, T.L. Bergman, and A.S. Lavine, *Fundamentals of Heat and Mass Transfer*, 6th Edition, John Wiley & Sons, Hoboken (NJ), 2007. [Chapter 1 for **Unit 0**.] Localízalo en la biblioteca
- F.P. Incropera, D.P. De Witt, T.L. Bergman, and A.S. Lavine, *Fundamentals of Heat and Mass Transfer*, 6th Edition, John Wiley & Sons, Hoboken (NJ), 2007. [Chapter 12 for **Unit 1** and Chapter 13 for **Unit 2**.] Localízalo en la biblioteca
- A. Rivas Nieto*, Máquinas Hidráulicas*, TECNUN Universidad de Navarra, Servicio de Publicaciones, 2008. [For **Unit 3**.]

- F. Santos Sabrás, *Máquinas Hidráulicas*, TECNUN Universidad de Navarra, Servicio de Publicaciones, 1999. [For **Unit 3**.]
- P. Gerhart, R. Gross y J. Hochstein, *Fundamentos de Mecánica de Fluidos*, 2ª Edición, Adison-Wesley Iberoamericana, Argentina, 1995. [Chapter 10 for **Unit 4** and Chapter 8 for **Unit 5**.] Localízalo en la biblioteca

Bibliografía complementaria:

- B. R. Munson, T. H. Okiishi, W. W. Huebsch, A. P. Rothmayer. *Fundamentals of Fluid Mechanics* (7th Edition), John Wiley & Sons, 2013. [Chapter 12 for **Unit 3**, Chapter 9 for **Unit 4**, and Chapter 7 for **Unit 5**.]
- Frank M. White, *Fluid Mechanics* (4th Edition), McGraw-Hill, 1998. [Chapter 11 for **Unit 3**, Chapter 9 for **Unit 4**, and Chapter 7 for **Unit 5**.] Localízalo en la biblioteca