3rd Year

Track 9: Industrial Mathematics

1 55001093 Applied Mathematics
2 55001082 Partial Differential Equations and Fourier Analysis

55001093 - APPLIED MATHEMATICS

CREDITS:	4.5 ECTS
DEPARTMENT:	Industrial and Applied Mathematics (MAT)
COURSE COORDINATOR:	Alejandro Zarzo
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Solving nonlinear equations and systems

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MODULE 2. Approximation of functions by polynomials. Numerical differentiation and integration

MODULE 3. Numerical Solution of Ordinary Differential Equations

This subject aims to introduce the student to numerical techniques for the study of the models that appear in the experimental sciences in the form of equations, systems, integrals, or ordinary differential equations.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES: Algebra (55000002), Calculus 1 (55000001), Calculus 2 (55000008), Differential equations (55000011), Fundamentals of programming (55000007), Materials Resistance (55000027)

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Basic mathematics: Calculus, algebra and differential equations.
- Fundamentals of programming.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Programming in Matlab environment.
- Modelling of problems using mathematical tools.
- Knowledge of the numerical problems in engineering, and the advantages and limitations of resolution methods studied in the course
- Ability to use media computations to implement, adjust and validate mathematical models of reality.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering,

science, and mathematics

- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

- ✓ Burden, J. Faires, A. Burden, Numerical Analysis, Cengage, Learning (2016)
- ✓ W. Cheney, D. Kincaid, Numerical mathematics and computing, Brooks/Cole (2012)
- ✓ J.D. Lambert, Numerical Methods for Ordinary Differential Systems: The Initial Value Problem, Wiley (1991)
- ✓ J.M. Sanz-Serna, Diez Lecciones de Cálculo Numérico, Publicaciones de la Universidad de Valladolid (2008)

OTHER MATERIALS

Class notes, and collection of solved problems available to students through Moodle platform.

55001082 –Partial Differential Equations and Fourier Analysis

CREDITS:	6 ECTS
DEPARTMENT:	Industrial and Applied Mathematics (MAT)
COURSE COORDINATOR:	Luis Sanz Lorenzo
TYPE:	Track (Industrial Mathematics)
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Introduction to Partial Differential Equations (PDEs)

MODULE 2. PDE models in engineering

MODULE 3. Fourier Series and Separation of Variables

MODULE 4. First order PDEs

MODULE 5. Fourier Transform

MODULE 6. Classification of second order PDEs

MODULE 7. Laplace and Poisson equations

MODULE 9. The wave equation

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Differential equations (55000011), Advanced Calculus (55000021), Calculus I (5500001), Calculus II (5500008)

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Familiarity with the basics of programming
- Ability to perform basic mathematics operations.
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• Study skills and concentration

- Ability to use the tools of calculus: Differential calculus of one and several variables and integral calculus of one variables.
- Knowledge of the theory and techniques of Ordinary Differential Equations.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):
- Modeling engineering problems through PDEs.
- Knowing the qualitative behavior of solutions of the main PDEs in engineering.
- Solving first order PDEs.
- Apply Fourier Series and Transform to different engineering problems.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

- Haberman, R. (2012). *Applied partial differential equations with Fourier series and boundary value problems*. Pearson Higher Ed.

- Vasy, A. (2015). *Partial Differential Equations* (Vol. 169). American Mathematical Soc.

- Olver, P. J. (2014). *Introduction to partial differential equations*. New York, NY, USA:: Springer.

- Folland, G. B. (2020). *Introduction to partial differential equations*. Princeton university press.

- Folland, G. B. (2009). *Fourier analysis and its applications* (Vol. 4). American Mathematical Soc..

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Class notes, and collection of solved problems available to students through Moodle platform.