Perturbation Methods

ECTS: 6 ECTS

COORDINATOR: Luis López Bonilla (bonilla@ing.uc3m.es)

UNIVERSITY WHERE THE COORDINATOR IS: UC3M

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No

LECTURER 1: Mariano Alvaro Ballesteros (mariano.alvaro@uc3m.es)

UNIVERSITY WHERE THE LECTURER 1 IS: UC3M

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No

LECTURER 2: Filippo Terragni (fterragn@ing.uc3m.es)

UNIVERSITY WHERE THE LECTURER 2 IS: UC3M

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LECTURER 3: Manuel Carretero Cerrajero (manuel.carretero@uc3m.es)

UNIVERSITY WHERE THE LECTURER 3 IS: UC3M

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? No

SUBJECT CONTENTS

- Basic notions of asymptotic analysis
- Approximation of integrals
- Solvability conditions for linear homogeneous problems
- Eigenvalue problems.
- Poincare-Linstedt method
- Scaling of singular perturbation problems
- Boundary layer methods and matched asymptotic expansions
- Asymptotic expansions coupled method.
- Method of multiple scales
- Chapman-Enskog method

METHODOLOGY

We present perturbation methods applied to physical and engineering systems and based on studying relevant examples. Solving the proposed problems and comparing these solutions to numerical or exact solutions is an essential part of the course.

LANGUAGE USED IN CLASS: Will depend on the audience

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system.

BIBLIOGRAPHY

- C. M. Bender & S. A. Orszag, Advanced Mathematical Methods for Scientists and Engineers. Addison-Wesley, N. Y. 1978. Springer 1999.

- L.L. Bonilla & M. Carretero, Perturbaciones singulares. Notas de clase. Universidad Carlos III de Madrid, 2009.

- L. L. Bonilla & S. W. Teitsworth, Nonlinear wave methods for charge transport. Wiley-VCH, Weinheim, 2010.

- E.J. Hinch, Perturbation methods. Cambridge UP, 1991.

- J. Kevorkian & J. Cole, Multiple Scale and Singular Perturbation Methods. Springer, N.Y., 1996.

- P. A. Lagerstrom, Matched asymptotic expansions. Springer, N. Y. 1988.

- A. H. Nayfeh, Introduction to Perturbation Techniques. Wiley, N.Y. 1981.

SKILLS

Basic:

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE2: To model specific ingredients and make appropriate simplifications in the model to facilitate their numerical treatment, maintaining the degree of accuracy, according to previous requirements.

CE3: To determine if a model of a process is well made and well mathematically formulated from a physical standpoint.

Modelling specialization:

CM1: To be able to extract, using different analytical techniques, both qualitative and quantitative models.

CM2: To know how to model elements and complex systems leading to well-posed formulated problems.

WILL YOU BE USING A VIRTUAL PLATFORM? No.

WILL YOU BE USING ANY SPECIFIC SOFTWARE? No.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

50% of the final mark: essays and participation in class.

50% of the final mark: exam.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

Written exam.
