Numerical Analysis (2 nd year
Preparatory cycle Department)

LESSON PLAN: Numerical Analysis

“Carried out as part of the PEDANTIC 2024-" training

Kamel

BENYETTOU

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Table des matières

I. Course Information

Preparatory cycle Department

Public cible : 2 nd year

Intitulé du cours : Numerical Analysis

Credit:03

Coefficient:02

Duration : 15 Weeks

Days : Sunday: 08h30-11h00

Room: Amphi 1 (course)

Room : (Roome A and B)

Professor

Cours, TD : Pr. Benyattou BENNABDERAHMANE

Tutorial (TD) : Dr Kamel BENYETOU

Contact : par mail au kamel.benyettou@nhsm.edu.dz and benyattou.benabderrahmane@nhsm.edu.dz

Availability :

At the office (Room : C2 :05) : Sunday, Monday, 11h00 -12h00

Answer on the forum: any question relating to the course must be posted on the dedicated forum so that you can all benefit from my answer, I undertake to answer the questions posted within 48 hours.

By mail : I undertake to respond by email within 48 hours of receipt of the message, except in the event of unforeseen circumstances, I draw your attention to the fact that the preferred communication channel is the forum, email is reserved for "emergencies" (in the event of a problem accessing the platform) and it must be used with discernment.

II. Course presentation

Numerical Analysis refers to the process of in-depth analysis of algorithms and natural approximations. It is considered a part of both computer science and mathematical sciences. It is used in several disciplines like engineering, medicine, social science, etc. Because this branch is concerned with understanding, creating, and implementing the algorithms for common problems.

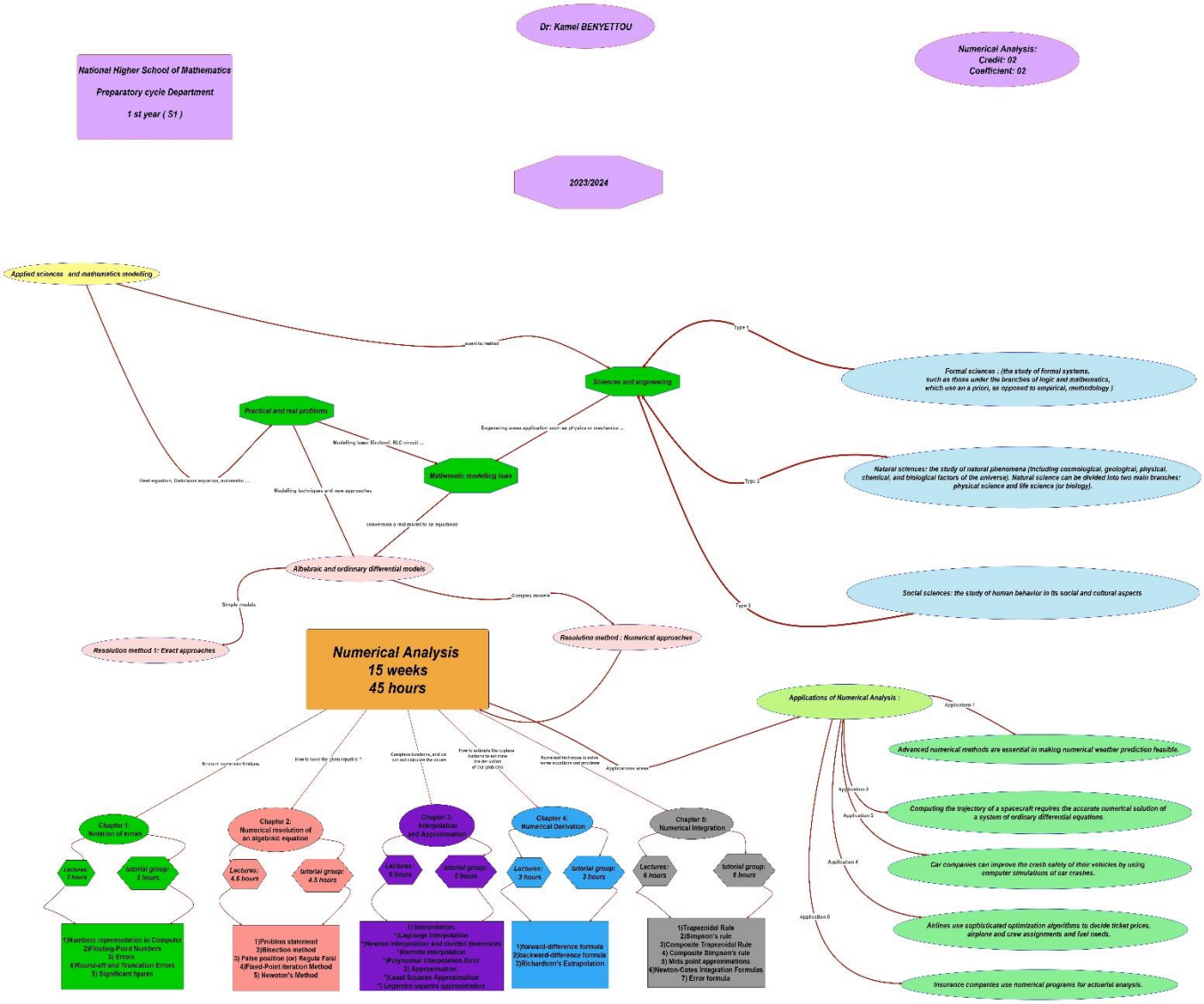
Some commonly used numerical computation methods include differential equations (that help predict planetary motion), linear algebra, etc.

Numerical analysis is a branch of mathematics that solves continuous problems using numeric approximation. It involves designing methods that give approximate but accurate numeric solutions, which is useful in cases where the exact solution is impossible or prohibitively expensive to calculate Brezinski, C.; Zaglia, M.R. (2013). Extrapolation methods: theory and practice. Elsevier. ISBN 978-0-08-050622-7.Brezinski, C.; Zaglia, M.R. (2013). Extrapolation methods: theory and practice. Elsevier. ISBN 978-0-08-050622-7.∗. Numerical analysis also involves characterizing the convergence, accuracy, stability, and computational complexity of these methods.Bultheel, Adhemar; Cools, Ronald, eds. (2010). The Birth of Numerical Analysis. Vol. 10. World Scientific. ISBN 978-981-283-625-0.Bultheel, Adhemar; Cools, Ronald, eds. (2010). The Birth of Numerical Analysis. Vol. 10. World Scientific. ISBN 978-981-283-625-0.∗ Numerical analysis can be divided into the following fields:Brenner, S.; Scott, R. (2013). The mathematical theory of finite element methods (2nd ed.). Springer. ISBN 978-1-4757-3658-8.Brenner, S.; Scott, R. (2013). The mathematical theory of finite element methods (2nd ed.). Springer. ISBN 978-1-4757-3658-8.∗

(1) Numerical Solutions of Linear Algebraic Equations.
(2) Numerical Solutions of Nonlinear Algebraic Equations.
(3) Interpolation and Extrapolation.
(4) Approximation Theory and Curve Fitting.
(5) Numerical Differentiation.
(6) Numerical Integration.
(7) Numerical Optimization.
(8) Numerical Solutions

One of the goals of numerical analysis is to compute answers within a specified level of accuracy.Working in double precision means that we store and operate on numbers that are kept to 52-bit accuracy, about 16 decimal digits.Quarteroni, A.; Saleri, F.; Gervasio, P. (2014). Scientific computing with MATLAB and Octave (4th ed.). Springer. ISBN 978-3-642-45367-0.Quarteroni, A.; Saleri, F.; Gervasio, P. (2014). Scientific computing with MATLAB and Octave (4th ed.). Springer. ISBN 978-3-642-45367-0.∗Brezinski, C.; Zaglia, M.R. (2013). Extrapolation methods: theory and practice. Elsevier. ISBN 978-0-08-050622-7.Brezinski, C.; Zaglia, M.R. (2013). Extrapolation methods: theory and practice. Elsevier. ISBN 978-0-08-050622-7.∗5

concept map



Content

The course is divided into five learning units, each learning unit is treated through educational sequences allowing the assimilation of the planned concepts, this assimilation is consolidated by learning activities where these notions are implemented, c This is one of the strengths of this course. All the learning units are described here, the detailed course plan and tutorial is available by accessing the online course then clicking on the classroom and the platform.

a. Introduction

The objectives of numerical analysis ((2 nd year CP 2 (Preparatory cycle Department)) are manifold and depend on the context in which it is used. However, here are some general objectives of numerical analysis: Solving complex mathematical problems, Obtain accurate numerical solutions, Studying the behaviour of dynamic systems, Studying the stability and convergence of numerical methods…

b. The specifics of the module

This involves presenting the different instructions of the digital method as well as its syntactic coding.

III. Preconditions (Les prérequis)

The prerequisites for numerical analysis depend on your level of study and the specific field in which you wish to specialise. However, here are some useful general skills and prerequisite knowledge:

- Fundamental mathematics: A solid understanding of differential and integral calculus is essential. This includes knowledge of derivatives, integrals, series, ordinary and partial differential equations and convergence.

- Linear Algebra: A good understanding of linear algebra concepts such as vectors, matrices, vector spaces, linear transformations, eigenvalues and eigenvectors is

required.

- Real analysis: Knowledge of real analysis concepts such as convergence of series, continuity, differentiability and integrability of functions is important.
- Basic Numerical Methods: You should have a basic understanding of common numerical methods such as solving non-linear equations, interpolation, function approximation, numerical integration and solving linear systems.
- Computer programming: Experience of programming, preferably in a language suitable for numerical analysis such as Python, MATLAB, or Julia, is very useful.
- Computer programming: Experience of programming, preferably in a language suitable for numerical analysis such as Python, MATLAB, or Julia, is very useful. You should be able to implement the numerical methods you learn and apply them to real-world problems.
- Error theory: Understanding how to assess and minimise errors in numerical calculations is crucial to obtaining accurate and reliable results.

- Application-specific knowledge: Depending on your specific field of application (engineering, physics, finance, etc.), you may need to acquire additional knowledge in this area to apply numerical analysis effectively.

IV. Learning goals

It is a complex performance, which you will gradually build by mastering knowledge, implementing know-how and doing it with professional know-how to use the most of numerical method.

V. Learning evaluation methods

The final evaluation is done through:

c. **A final table exam :**which covers everything you have seen in this course during the semester, during this exam, which counts for 50% of the final grade .

a. **Continuous and regular evaluation:** with the remaining 50%, it allows you to earn points throughout the semester, this continuous evaluation is carried out in different forms,You have :

- ✓ To solve problems similar or close to the problems dealt with during the tutorials, questions.
- ✓ To answer summary questions (via multiple choice questions)
- ✓ To answer reflection questions. (you will be trained to answer this type of question by the questions asked during the tutorials, courses and during the quizzes that will be offered to you online)

Teaching-learning activities

So that you can assimilate the concepts of the Numerical Analysis module and design a system that meets the client's requirements, the course offers several methods with their specificities and advantages.

- ✓ Knowledge is transmitted through a lecture, I expect you to take notes which will help you master the concepts essential to carrying out the learning activities proposed during the session.
- ✓ You are also invited to participate in debates, initiated by questions asked on the current educational sequence, without any form of evaluation, with the aim of

developing exchanges between you, I invite you to participate freely in these debates.

- ✓ Tutorials are scheduled at the end of each chapter so that you can check your ability to use knowledge in solving the exercises and the problems proposed.

Operating methods

The course is organized in:

- Theoretical sessions to provide you with all the knowledge needed to deal with practical problems.
- In tutorial sessions (TD), present after each learning unit (chapter), so that you can mobilize knowledge in solving the exercises and problems proposed.

Help Resources

Resources are made available to you on the platform:

- ✓ Courses of each chapter
- ✓ Some Book of Numerical Analysis (link+PDF)
- ✓ Work sheet problem with solutions
- ✓ Proposed exercises with solutions.