Course Syllabus

1. **Course Title:** Computational Methods in Civil Engineering
2. **Course Code:** ACMC120421
3. **Credit Units:** 02 credits (2/0/4) (2 units of theory, 0 unit of practice)
   Duration: 10 weeks (3 hours of theory + 0*3 hours of practice + 6 hours of self-study/week)
4. **Course Instructors:**
   1/ MSc. Lâm Phát Thuận
   2/ Assoc. Prof. Dr. Nguyễn Hoài Sơn
5. **Course Requirements**
   Prerequisite courses: None
   Previous courses: Advanced Mathematics A1 (MATH130101), A2 (MATH130201), A3 (MATH130301)
   Parallel course: None
6. **Course Description**
   The course provides computational methods, especially numerical methods, to solve mathematical problems necessary for civil engineering such as integration, ODEs, PDEs, linear algebra equations, and analysis of experimental data. The course also aims at introducing students to programming and numerical methods within a technical computing environment. MATLAB will be used as the framework for presentation, explanation, discussion and application of numerical methods.
7. **Course Goals**

Goals	Goal description	Programme ELOs
G1	Apply mathematics and science knowledge in engineering field	1.1
G2	Establish mathematical model and solve the civil engineering problems	2.1
G3	Team-work skills and reading english materials skills	3.1, 3.3

8. **Course Learning Outcomes (CLOs)**

CLOs		CLO Description	Programme ELOs
G1	**G1.1**	Present the role and the meaning of numerical method to solving the problems related to civil engineering field.	1.1
	G1.2	Present the advantages and disadvantages of numerical method in solving civil engneering problems.	1.1
G2	**G2.1**	Establish mathematical model, formulate the equation of the problems	2.1
	G2.2	Analyze and choose the suitable method to solve each type of the problems. Estimate and process a set of practical data	2.1

G3	**G3.1**	Group working to solve particular problems related to civil engneering field effectively.	3.1
	G3.2	Ability to understand english terms related to the subject.	3.3

9. Learning Resources

- Textbook:

1. Steven C. Chapra. "Applied Numerical Methods with MATLAB for engineers and scientists", Mc Graw Hill, 2008

- References:

1. Erwin Kreyszig. "Advanced Engineering Mathematics", John Wiley & Sons, 1992.
2. R. C. Hibbeler. "Structural Analysis", Pearson Prentice Hall, 2012
3. Won Y. Yang. "Applied Numerical Methods using MATLAB", John Wiley & Sons, 2005
4. Nguyễn Hoài Sơn. "Phương pháp tính ứng dụng trong tính toán kỹ thuật", NXB ĐH Quốc Gia Tp.HCM, 2008.
5. Nguyễn Hoài Sơn. "Ứng dụng MATLAB trong tính toán kỹ thuật" – T1", NXB ĐH Quốc Gia Tp.HCM, 2000.

10. Student Assessment

- Grading scale: **10**
- Assessment plan:

Type	Content	Timeline	Assessment method	CLOs	Rate (%)
Assignments					**20**
EX#1	Linear and nonlinear equation /systems related to civil engineering problems	Week 5	In-class Assignments	G2.1, G2.2	5
EX#2	Practical data processing: Curve fitting and interpolation function	Week 7	In-class Assignments	G1.2, G2.2,	5
EX#3	Solve Ordinary Differential equation using Runge – Kutta methods	Week 10	In-class Assignments	G2.1, G2.2	10
Midterm					**30**
	- Use Interpolating polynomial to calculate the value at a point inside the data range - Solve linear and nonlinear systems - Curve fitting problems	Week 8	Paper Test	G2.1, G2.2, G3.2	
Final					**50**
	- All of the topics covered throughout the semester are included. - 10 minutes per group.		Group Presentation (Rubric assessment)	G1.1, G1.2, G2.1, G2.2, G3.1, G3.2	

11. Course Content:

Week	Content	CLOs
1	***Chapter 1:*** **Error**	
	A/ **Content and pedagogical methods in class***: (3h)* **Content:** 1.1 Approximation, absolute error and relative error 1.2 Certain and uncertain digits 1.3 Types of error 1.4 Functional Error **Pedagogical methods**: + Presentation of lecture	G1.1, G1.2, G3.1
	B/ Self-study content: *(6h)* + Read other types of error	G1.1, G3.1
2	***Chapter 2:*** **Interpolation - Extrapolation**	
	A/ **Content and pedagogical methods in class***:: (3h)* **Content:** 2.1 Introduction to Interpolation 2.2 Lagrange Interpolating Polynomial 2.3 Newton Interpolation Polynomial 2.4 Extrapolation **Pedagogical methods**: + Presentation of lecture + Students solve problems and get rewarded score	G1.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Read Hermit Interpolating Polynomial + Homework of the chapter + Matlab coding: Newton and Lagrange Interpolation Polynomial	G2.2, G3.2
3	***Chapter 3:*** **Single variable Nonlinear Equation**	
	A/ **Content and pedagogical methods in class***: (3h)* **Content:** 3.1 Overview 3.2 Iterative Method 3.3 Applications **Pedagogical methods**: + Presentation of lecture + Students solve problems and get rewarded score	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework of the chapter + Read other methods that can be applied to solve nonlinear equation	G2.1,G2.2
4	***Chapter 4:*** **Linear and Nonlinear Systems**	

	A/* Content and pedagogical methods in class: (3h)* **Content:** 4.1 Matrix and Vector Algebra Overview 4.2 Linear Algebraic Equation System **Pedagogical methods**: + Presentation of lecture + Group working	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Read next sections	G2.1, G2.2
5	***Chapter 4:* Linear and Nonlinear Systems** *(Cont)*	
	A/* Content and pedagogical methods in class: (3h)* **Content:** 4.3 Nonlinear equation systems 4.4 Applications **Pedagogical methods**: + Presentation of lecture + Group coding + Individuals solve problem and get rewarded score	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework: problems of the chapter	G2.1, G2.1
6	***Chapter 5:* Practical Data Processing**	
	A/* Content and pedagogical methods in class: (3h)* **Content:** 5.1 Linear Regression 5.2 Higher-order polynomial Regression 5.3 Nonlinear Regression **Pedagogical methods**: + Presentation of lecture + Group coding + Individuals solve problem and get rewarded score	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework: Linear, Nonlinear and Polynomial function + Read next sections + Matlab coding with practical data	G2.1, G2.2
7	***Chapter 5:* Practical Data Processing** *(Cont)*	
	A/* Content and pedagogical methods in class: (3h)* **Content:** 5.4 Integrating Functions Regression 5.5 Approximation Regression based on Taylor expansion **Pedagogical methods**:	G2.1, G2.2, G3.1, G3.2

	+ Presentation of lecture + Group coding + Individuals solve problem and get rewarded score	
	B/ Self-study content: *(6h)* + Homework: problems of the chapter + Matlab coding with practical data	G2.1, G2.2
8	***Chapter 6:*** **Numerical Integration**	
	A/ **Content and pedagogical methods in class***: (3h)*** **Content:** 6.1 Trapezoidal Rule 6.2 Simpson's Rule 6.3 Gauss Quadrature **Pedagogical methods**: + Presentation of lecture + Group discussion and coding	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework: problems of the chapter	G2.1, G2.2
9	***Chapter 7:*** **Numerical Differentiation**	
	A/ **Content and pedagogical methods in class***: (3h)*** **Content:** 7.1 Initial-Value Problems 7.2 Boundary-Value Problems **Pedagogical methods**: + Presentation of lecture	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework + Read next sections	G2.1, G2.2
10	***Chapter 7:*** **Numerical Differentiation** ***(Cont)***	
	A/ **Content and pedagogical methods in class***: (3h)*** **Content:** 7.3 Boundary-Value Problems *(Cont)* 7.4 Complex Problems **Pedagogical methods**: + Presentation of lecture + Group coding	G2.1, G2.2, G3.1, G3.2
	B/ Self-study content: *(6h)* + Homework: problems of the chapter	G2.1, G2.2

12. Learning Ethics

Students must do homework by themselves. If plagiarism is found students will get zero point.

Students must finish index 10 to pass the course.

13. Date of first approval: August 1st, 2012

14. Approved by:

Dean	Head of Department	Instructor
A/Prof. Dr. Nguyễn Trung Kiên	**Dr. Phạm Tấn Hùng**	**MSc. Lâm Phát Thuận**

15. Date and Up-todate content

1st time: Date -	Instructor Head of Department