ECTS

Course information in english

General course information:

Course title:	Numerical Analysis	**Course code:**	ΓΚ1801
Credits:	5	**Work load (hours):**	125
Course level:	Undergraduate ☑	Graduate ☐	
Course type:	Mandatory ☑	Selective ☐	
Course category:	Basic ☑	Orientation ☐	
Semester:	3	**Hours per week:**	4

Course objectives (capabilities pursued and learning results):

The course is designed to provide students with the tools necessary to solve numerically known mathematical problems that arise in civil engineering problems (such as solving linear systems, solving differential equations and non-linear equations, data approximation problems, etc.) Using the MATLAB software package, which is widely used by engineers and scientists makes it possible to implement and study the methods presented during the course.

Upon successful completion of the course the student will:

- Understands methods of solving linear systems with straightforward and iterative methods and be able to judge which is the appropriate method to use in each case.
- Has knowledge of the basic methods of solving nonlinear equation systems.
- • Knowledge of data access and interpolation methods with polynomial functions
- • Has knowledge of basic methods of numerical derivation with finite difference and integration, which will be useful in solving differential equations by numerical methods.
- Know the basic numerical integration methods and be able to judge what is the appropriate method to use in the problem at hand.
- Know the basic methods of solving differential equations and systems of differential equations and equating finite differences for various boundary conditions
- Understand the impact of finite arithmetic errors and method errors on the numerical results it will receive from executing the scheduled methods.
- Has basic knowledge of MATLAB software

General Skills

- Search, analyze and synthesize data and information, using the necessary technologies
- Decision making
- Independent work
- Exercising criticism and self-criticism
- Promoting free, creative and inductive thinking
- Using new technologies to solve problems

Prerequisites:
-Mathematics I and Mathematics II

Instructor's data:

Name:	Theodoros KARAKASIDIS
Level:	Professor
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Other tutors:	

Specific course information:

Week No.	Course contents	Hours	
		Course attendance	**Preparation**
1	Introduction. Measuring Errors. Sources of Error. Floating Point Representation. Machine ε. Errors.	**4**	**2**
2	Solution of equations system, Direct methods Gauss elimination, Gauss-Jordan and Thomas.	**4**	**2**
3	LU factorization. Unstable systems, table norms.	**4**	**2**
4	Recursive methods of Jacobi, Gauss-Seidel, S.O.R.. Comparison of recursive methods and definition of spectral radius.	**4**	**2**
5	Non-linear systems, Newton's method	**4**	**2**
6	Solution of equations. Bisection method. Linear interpolation method. Secant Method.	**4**	**2**
7	Newton- Raphson Method. Roots of polynomial	**4**	**2**
8	Interpolation. Tables of differences and finite differences operators. Newton-Gregory Interpolation.	**4**	**2**
9	Lagrange Interpolation. Newton Interpolation. Hermite Interpolation.	**4**	**2**
10	Quadratic and Cubic "splines" Interpolation. Least square method	**4**	**2**
11	Integration. Newton Cotes Integration formula. Trapezoidal Rule. Simpson's 1^{st} and 2^{nd} Rule of integration.	**4**	**2**
12	Richardson method. Romberg Integration. Gauss Integration.	**4**	**2**
13	ODE Primer. Euler's Method. Runge-Kutta 2^{nd}. Runge-Kutta 4^{th}.	**4**	**2**
14	Finite Difference Method. Shooting Method	**4**	**2**

Additional hours for:			
Class project	**Examinations**	**Preparation for examinations**	**Educational visit**
20	3	18	

Suggested literature:
• Sarris I., Karakasidis T., Numerical Methods for Engineers, Tziolas Publishing, 4th edition, Thessaloniki, Greece 2017 (in Greek) • G.D. Akribis – B.A. Dougalis, «Introduction to numerical analysis», Cretan University Editions, 1998. (in Greek) • S. C. Chapra, R. P. Canade, Numerical methods for engineers, McGraw Hill, 1998. • G.E. Forsythe – M.A. Malcolm – C.B. Moler , «Computer methods for mathematical computations», Prentice-Hall, 1977

Teaching method *(select and describe if necessary* - **weight***):*		
Teaching	☑	50%
Seminars	☐	…….%
Demonstrations	☐	…….%
Laboratory	☑	30%
Exercises	☑	20%
Visits at facilities	☐	…….%
Other *(describe):* …….	☐	…….%
Total		100%

Evaluation method *(select)*- **weight:**				
	written	*%*	*Oral*	*%*
Homework	☑	20	☐	
Class project	☐		☐	
Interim examination	☐		☐	
Final examinations	☑	80	☐	
Other *(describe):* ……	☐		☐	