Academic subject: Numerical Methods for Computer Graphics

Degree Class: L-35 – Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2018/2019
		Kind of class: Optional	**Year:** / **Period:** 2
			ECTS: 7 divided into **ECTS lessons:** 6.5 **ECTS exe/lab/tutor:** 0.5

Time management, hours, in–class study hours, out–of–class study hours
lesson: 52 exe/lab/tutor: 8 in–class study: 60 out–of–class study: 115

Language: Italian	**Compulsory Attendance:** no		
Subject Teachers: Pierluigi Amodio	**Tel:** +39 080 5442703 **e-mail:** pierluigi.amodio@uniba.it	**Office:** Department of Mathematics Room 2, 4thFloor	**Office days and hours:** Tuesday 14:00—16:00. Other days by appointment only.

Prerequisites:
The knowledge gained in the course Numerical Calculus I and II, basics of geometry and linear algebra.

Educational objectives:
Acquiring some knowledge about the main properties and issues related to the computer graphics. Acquiring basic knowledge about the development of 3D models in Matlab environment.

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
- Understanding the power of computer graphics and the problems connected with the fulfillment of shapes by means of basic mathematical objects.

Applying knowledge and understanding:
- Acquiring skills in programming and testing of numerical codes for computer graphics.

Making judgements:
- Being able to detect a proper programming strategy to solve non-elementary problems in computer graphics.

Communication:
- Being able to explain rigorously the basic theory of the numerical algorithms.

Lifelong learning skills:
- Capability of studying and applying the techniques learned during the course to realize 3D models.

Course program

1. **PARAMETRIC REPRESENTATION**
   Parametric representation of curves and surfaces. Analysis of strengths and weaknesses in computer graphics.
2. **POLYNOMILA AND B-SPLINE CURVES**
   Bernstein polynomials and Bézier curves. Main properties. De Casteljau algorithm. B-spline curves. De Boor algorithm. Computation of the derivatives, relation between regularity and multiplicity of the knots. Degree elevation and knot insertion algorithms. Parametric interpolation.
3. **RATIONAL CURVES AND NURBS**
   Rational curves and B-spline rational curves. Properties. Representation of a conic section. NURBS functions.
4. **SURFACES**
   Representation of free-form surfaces, surface of revolution, translation and rotation. Bilinear and ruled surfaces, general cylinders, swung surfaces.
5. **MATLAB IMPLEMENTATION**

Matlab implementation of all the proposed algorithms.

Teaching methods:
Lectures and exercise sessions in the Computer Centre.

Auxiliary teaching:
Handouts, notes and Matlab codes supplied during the course lectures.

Assessment methods:
The exam consists in the discussion of two Matlab projects, proposed and realized by the students (individually or in group) and an oral examination.

Bibliography:

- Piegl, W. Tiller, *The NURBS book*, Springer, 1997.
- F. Farin, *Curves and Surfaces for Computer Aided Geometric Design*, Academic Press, 1997.
- Lamberti, C. Dagnino, *Elementi di matematica numerica per la grafica*, Levrotto & Bella, 2008.