MATHEMATICS. MASTER IN ECONOMICS.
WORK SYLLABUS

WEEK	SESSION	CONTENTS
1	1	**Topic 1. Linear Algebra.** Matrices. Operations with matrices. Transpose matrix. Inverse matrix. Elementary transformations of matrices. Equivalent matrices. Echelon matrix. Rank of a matrix by computing an equivalent echelon matrix. Computation of the inverse matrix by applying Gauss-Jordan method. Short review of determinants.
	2	**Topic 1. Linear Algebra.** Introduction to linear systems. Matricial expression of a linear system. Augmented matrix. Rouché-Fröbenius Theorem. Gauss technique to solve a linear system. Cramer rule. Exercises to classify linear systems depending on one or more parameters.
2	1	**Topic 1. Linear Algebra.** Similar matrices. Diagonalizable matrix. Eigenvalues and eigenvectors. Characteristic polynomial. Computation of eigenvalues and eigenvectors. Geometric and algebraic multiplicity of an eigenvalue. Characterization of diagonalizable matrices. Illustrative exercises.
	2	**Topic 1. Linear Algebra.** Orthogonal matrix. Similar-congruent matrices. Characterization of symmetric matrices by means of the existence of a similar-congruent diagonal matrix. Gram-Schmidt orthogonalization method to compute orthogonal eigenvectors associated to the same eigenvalue. Exercises about diagonalization of matrices.
3	1	**Topic 1. Linear Algebra.** Quadratic forms. Introduction. Associated symmetric matrix. Types of quadratic forms. Classification of a quadratic form by means of the sign of the eigenvalues of the associated symmetric matrix. Classification of a quadratic form by means of Jacobi diagonalization.
	2	**Topic 1. Linear Algebra.** Exercises about quadratic forms.
4	1	**Topic 2. The Euclidean Space R^n.** Scalar product of two vectors. Norm of a vector. Angle between two vectors. Polar coordinates. Topology in R^n: open and closed balls. Interior, boundary and closure points of a set. Open and closed sets. Bounded and compact sets. Convex sets.
	2	**TEST 1: Topic 1** **Topic 2. The Euclidean Space R^n.** Introduction to functions in several variables. Level surfaces/curves. Illustrative examples.
5	1	**Topic 2. The Euclidean Space R^n.** Limit of a function of several variables. Iterated limits. Limits through paths. Sandwich criterion to compute a limit. Exercises to compute limits.

	2	**Topic 2. The Euclidean Space R^n.** Continuous functions. Properties. Global and local extrema of a function. Weierstrass Theorem. Computation of global extrema by using level curves. Exercises to study the continuity of a function and to compute global extrema by using level curves.
6	**1**	**Topic 3. Differential Calculus of Several Variables. Part I.** Directional derivatives. Partial derivatives. Geometric interpretation. Gradient. Differentiable function. Differential function. Main properties and results, and geometric interpretation of differentiable functions. Tangent plane.
	2	**Topic 3. Differential Calculus of Several Variables. Part I.** Exercises to compute directional derivatives and to study the differentiability of a function.
7	**1**	**Topic 3. Differential Calculus of Several Variables. Part I.** Direction of maximum increasing of a differentiable function. Chain rule. Related exercises.
	2	**Topic 3. Differential Calculus of Several Variables. Part I.** Exercises about the topic.
8	**1**	**TEST 2: Topics 2 and 3** **Topic 4. Differential Calculus of Several Variables. Part II.** Second order derivatives. Hessian matrix.
	2	**Topic 4. Differential Calculus of Several Variables. Part II.** Taylor approximation of first and second order. Implicit function theorem. Related exercices.
9	**1**	**Topic 4. Differential Calculus of Several Variables. Part II.** Exercises about the topic.
	2	**Topic 5. Unconstrained Optimization Problems and Convex Analysis.** Relative extrema of a function. Necessary and sufficient conditions for relative extrema (first and second order conditions). Exercises to compute the relative extrema of a function.
10	**1**	**Topic 5. Unconstrained Optimization Problems and Convex Analysis.** Convex and concave functions. Characterization of convex/concave functions in terms of the signature of the Hessian matrix. Characterization of the global minimum (resp. maximum) of a convex (resp. concave) differentiable function. Related exercises.
	2	**Topic 5. Unconstrained Optimization Problems and Convex Analysis.** Exercises about the topic. **TEST 3: Topics 4 and 5**
11	**1**	**Topic 6. Constrained Optimization Problems.** General definition of a constrained optimization problem. Optimization problems with

		equality constraints. Lagrange function. Lagrange multipliers. Necessary and sufficient conditions for the solutions of a constrained optimization problem. Illustrative exercises.
	2	**Topic 6. Constrained Optimization Problems.** Exercises to solve an optimization problem with equality constraints.
12	**1**	**Topic 6. Constrained Optimization Problems.** Optimization problems with inequality constraints. Active restrictions. Constraint qualifications. Kuhn-Tucker Theorem.
	2	**Topic 6. Constrained Optimization Problems.** Exercises to solve an optimization problem with inequality constraints.
13	**1**	**Topic 7. Difference Equations.** Parts 7.1 and 7.2
	2	**Topic 7. Difference Equations.** Exercises.
14	**1**	**Topic 7. Difference Equations.** Parts 7.3 and 7.4
	2	**Topic 7. Difference Equations.** Exercises.