	Course name: MATH 326 Dynamical Systems			Department: Mathematics			Semester	
							6	
	Methods of Education						Credit (ECTS)	
	Lecture	Recitation/ (Etud)	Lab	Exams	Homework/ Quiz	Other	Total	6
	42	0	0	40	0	98	180	
Language	English							
Compulsory/Elective	Elective							
Prerequisites	None							

Course Contents

Weeks	Subjects
1	• Preliminary concept of Dynamical Systems • Differential Equations
2	• Simple Differential Equations and Applications • Existence and Uniqueness Theorem
3	• PlanarSystems • Canonical Forms • Eigenvectors Defining Stable and Unstable Manifolds
4	• Phase Portraits of Linear Systems in the Plane • Linearization and Hartman's Theorem • Constructing Phase Plane Diagrams
5	• Interacting Species • Competing Species
6	• Predator-Prey Models • Other Characteristics Affecting Interacting Species
7	• Hamiltonian Systems, Lyapunov Functions, and Stability • Hamiltonian Systems in the Plane • Lyapunov Functions and Stability
8	• Bifurcation Theory
9	• Bifurcations of Nonlinear Systems in the Plane
10	• Normal Forms • Multistability and Bistability
11	• Three-Dimensional Autonomous Systems and Chaos • Linear Systems and Canonical Forms

	12	• Nonlinear Systems and Stability • The R¨ossler System and Chaos
	13	• Local and Global Bifurcations • Bifurcations Involving Homoclinic Loops
	14	• Delay Differential Equations • Introduction and the Method of Steps • Applications in Biology • Applications in Nonlinear Optics

Course Objectives	**1.**To familiarize students with the basic concepts, principles and methods of Dynamical Systems **2.**To provide the knowledge of applications of Dynamical Systems
Learning Outcomes and Competences	After completing this course, students should demonstrate competency in the following skills: • To understand the dynamics, and the structure of the phase-plane of linear systems. • To apply local techniques, for the analysis of the local phase portrait of non-linear systems. • To apply Lyapunov and invariant manifold methodologies, in order to analyze the stability properties of nonlinear systems. • To understand and recognize fundamental nonlinear phenomena such as the emergence of limit cycles, and bifurcations. • To understand and apply global non-linear techniques, based on Poincaré-Bendixson theorem.
Textbook and /or References	• Dynamical Systems with Applications using MATLAB 2nd ed., Stephen Lynch (Author), Birkhäuser; 2nd ed. 2014

Assessment Criteria		If any, mark as (X)	Percentage (%)
	Midterm Exams	X	40
	Quizzes		
	Homework		
	Projects		
	Term Paper		
	Laboratory work		
	Other		
	Final Exam	X	60

Instructors	