Course Syllabus: Contemporary Topics in Analysis - AMCS 294A

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	AMCS 294A
Course Title	Contemporary Topics in Analysis
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Sun Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Hector Fidencio Sanchez Morgado	HECTOR.SANCHEZMORGADO@KAUST.EDU.SA			

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	The course is an introduction to the qualitative theory of ordinary differential equations including the following topics: The theory of existence, uniqueness and continuous dependence of the solutions on initial conditions and parameters. A complete study of the behavior of the linear systems with constant coefficients. A local study of the qualitative behavior around singular points and periodic orbits. The study of some special instances: gradient systems, Hamiltonian systems, Van der Pol equation, limit sets of planar sytems. Introduction to bifurcation theory.
Course Description from Program Guide	
Goals and Objectives	**That the student acquires analytic and geometric tools to understand the behavior of the solutions of an ordinary differential equation without solving the equation.** **The student will be able:** **1. To study the local behavior of solution around an equilibrium point or periodic orbit.** **2. To study the global qualitative behavior of a planar system.** **3. To study in some cases, the bifurcations of a system with parameters.**
Required Knowledge	A good knowledge Linear Algebra. A knowleddge of the basic facts of Mathematical Analysis such as uniform convergence.
Reference Texts	1. **M. Hirsch S. Smale, Differential Equations, Dynamical Systems and linear Algebra. Academic Press.** 2. **L. Perko. Differential Equarions and Dynamical Systems. Third edition. Texts in applied Mathematics. Springer** 3. **V.I. Arnold. Ordinary Differential Equations. Third Edition. Springer.**
Method of evaluation	**40.00**% - Final exam **30.00**% - Midterm exam **30.00**% - Homework /Assignments
Nature of the assignments	The assignments will consist in the solution of a list of exercises.

Course Policies	10 percent penalization for late handing of assignments.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 01/27/2019 Thu 01/31/2019	Linear systems with constant coefficients, the exponential of a matrix.
2	Sun 02/03/2019 Thu 02/07/2019	Qualitative behavior of the solutions a linear system.
3	Sun 02/10/2019 Thu 02/14/2019	Existence and uniqueness of the solutions of an ordinary differential equation.
4	Sun 02/17/2019 Thu 02/21/2019	Linear systems with periodic coefficients, fundamental solutions.
5	Sun 02/24/2019 Thu 02/28/2019	Continuous dependence on initial conditions and parameters The flow defined by a differential equation.
6	Sun 03/03/2019 Thu 03/07/2019	Linearization, the stable manifold theorem.
7	Sun 03/10/2019 Thu 03/14/2019	The Hartman Grobman theorem.
8	Sun 03/17/2019 Thu 03/21/2019	Stability of equilibria. Lyapunov functions. Gradient and Hamiltonian systems.
9	Sun 03/24/2019 Thu 03/28/2019	Spring Break
10	Sun 03/31/2019 Thu 04/04/2019	Global existence theorems. Limits sets.
11	Sun 04/07/2019 Thu 04/11/2019	Periodic orbits, the Poincare map.
12	Sun 04/14/2019 Thu 04/18/2019	The stable manifold theorem for periodic orbits.
13	Sun 04/21/2019 Thu 04/25/2019	The Poincare Bendixson Theory.
14	Sun 04/28/2019 Thu 05/02/2019	The Van der Pol equation.
15	Sun 05/05/2019 Thu 05/09/2019	Bifurcations at nonhyperbolic points.
16	Sun 05/12/2019 Thu 05/16/2019	The Hopf bifurcation
17	Sun 05/19/2019 Thu 05/23/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.