جامعة آل البيت
دائرة ضمان الجودة والتخطيط

بسم الله الرحمن الرحيم

جامعة آل البيت

College of Science
Department of Mathematics
Course syllabus: Advanced Ordinary Differential Equations
Second semester 2019/2020

1. Instructor Information:

Instructor Name	Safwan Al-Shara'		
Office Hours	Monday, Wednesday	9:30 – 11:00	
	Thursday	1:00 – 2:00	
Office Number and Telephone Extension	2201		
Email	safwan_alshara973@yahoo.com		

2. Course Description:

Preliminaries and examples for initial value problems, Existence and uniqueness theorems, Boundary value problems and Sturm-Liouville theory, Green's functions, Phase plane, Autonomous systems and Stability, Alost linear systems, Liapunov's second method, periodic solutions, Applications.

3. Course Information:

Course Code: 401703	**Course Title:** Advanced Ordinary Differential	**Level:** Master degree
Delivery Mode: Lecture	**Pre-requisite:** None	**Day(s) and Time:** Thursday 2:00-5:00
Academic year: 2019-2020	**Semester:** Second semester	**Credit Hours:** 3

4. Course Objectives:

This course provides a continuation of the theory and solution of ordinary differential equations (ODEs). The emphasis is on developing the mathematical properties and solution methods that characterize ordinary differential equations, including a more detailed examination of eigenvalues and eigenvectors, stability, the phase plane. In addition,
1. Working with systems of ordinary differential equations and non-linear ordinary differential equations is also stressed.
2. Developing and understanding and appreciation of the qualitative behavior of the solution vis-a-vis orbits and phase plane portraits;
3. Being able to formulate and find solutions to more complex mathematical problems encountered in the applied sciences and engineering involving differential equations.
The emphasis is on improved critical thinking skills with regard to using extending the methods learned in Ordinary differential equations I & II to solve more difficult problems involving differential equations. Theory and analysis is stressed throughout
4. Study Existence and Uniqueness theorems, BVP's and SLP's , Green's function with applications, Stability and Liapunov's second method.

5. Intended Student Learning Outcomes :

After successfully completing this course the expectation is that students will be able to:

1. Examine the theory of existence and uniqueness of the solution of linear and nonlinear ODE's .
2. Apply Picard's method of successive approximations to the proof of the existence and uniqueness theorem.
3. Identify classes of non-linear ordinary differential equations.
4. Apply Green's function approach to solve some BVP's.
5. study the Stability of some nonlinear DE's and apply Liapunov's method.

6. Course Content:

The Existence and Uniqueness Theorems

- Initial value problems (IVP's)
- Picard method of successive approximations
- Boundary Value problems (BVP's)

Calculus of Variation

- Some famous problems
- Basic Lemmas, Euler – Lagrange equation (E-L eq.) , special cases
- Applications

Boundary Value Problems and Sturm-Liouville Theory ❖ Basic definitions ❖ Sturm – Liouville Boundary Value Problems (SLP's) ❖ Lagrange Identity ❖ Nonhomogeneous Boundary Value Problems ❖ Adjoint BVP ❖ Fredholm Alternatives ❖ Green's function approach ❖ Modified Green's function
Nonlinear Differential Equations and Stability ❖ The Phase Plane: Linear Systems ❖ Autonomous Systems and Stability ❖ Almost Linear Systems ❖ Liapunove's second method

7. Assessment:

Assessment	Grade Proportion	Week/Dates
Class Work (Quizzes, Homework and Attendance of the lecture)		
First exam	**30 %**	**Thursday 12/3/2020**
Second exam	**30 %**	**Thursday 16/4/2020**
Final exam	**40 %**	**End of Semester**
Total	**100 %**	

8. Text Book:

The main reference	Elementary Differential Equations and Boundary Value Problems
Author(s)	Boyce W. , DiPrima R.
Publisher	JOHN WILEY & SONS, INC.
Year	2012
The edition	10^{th} edition
The reference website	https://www.academia.edu/35728568/Elementary_Differential_Equations_and_Boundary_Value_Problems_10th_.pdf?auto=download

9. References and additional resources:

1)	Michael D. Greenberg , **Advanced Engineering Mathematics**, Pearson, 2nd edition, 1998. https://www.engineeringbookspdf.com/download/?file=7157
2)	Michael D. Greenberg , **Foundation Of Applied Mathematics**, Dover Publications, 2nd edition, 2013. https://www.perlego.com/book/113158/foundations-of-applied-mathematics-pdf
3)	Lynn H. Loomis and Shlomo Sternberg, **ADVANCED CALCULUS, REVISED EDITION**, Jones And Bartlett Publishers. https://archive.org/details/LoomisL.H.SternbergS.AdvancedCalculusRevisedEditionJonesAndBartlett/page/n553/mode/2up