Philadelphia University - Faculty of Engineering
MSc. – Mechatronics Engineering Department
First Semester 2016/2017

Course Syllabus	
Course Title:	Advanced Engineering Mathematics (640711).
Text Book:	Advanced Engineering Mathematics, K.A.Stroud, Industrial Press, 2011
Class Time:	Sunday 15:00-18:00
Instructor:	Dr. Mohammed Mahdi
email	M_selman@philadelphia.edu.jo
website	www.philadelphia.edu.jo/academics/dr. mohammed mahdi
Prerequisites	BS degree in Mechatronics or related fields
Office Hours:	Monday, Wednesday : 13:00-15:00

Course Description:

Based on the knowledge of the undergraduate level students get the necessary skills in analytical and computational mathematical methods to work in a scientific environment and solve engineering problems in research and development projects.

Course outcomes \ competencies

On completing the course, students will be able to have the following skills:

- **Knowledge and understanding:-**
  - A1. Understand analytical and computational principles in advanced mathematical methods.
  - A2. Knowledge of the range of transformations method for the solution of advanced problems.
- **Intellectual skills: -**
  - B1. Able to formulate strategies for solutions to advanced engineering problems based on the methods taught.
  - B2. Able to choose mathematical tools appropriate for advanced engineering problems.
- **Professional and practical skills:-**
  - C1. Able to apply advanced mathematical methods in engineering problems.
  - C2. Know the potential and the limits of computational solutions and choose algorithms and software accordingly.
- **General and transferable skills: -**
  - D1. Use a structured approach to advanced quantitative engineering problems.
  - D2. Communicate solutions adequately.

week	Topics
1,2,3	**Laplace Transform: A) The Laplace Transform**: -Definition of the Laplace transform, Laplace of some elementary functions, some important properties of the Laplace transform, Initial and Final value theorems, Methods of finding Laplace transform. **B) The Inverse Laplace Transform:** -Definition of inverse Laplace transform, , some important properties of inverse Laplace transform, methods of finding inverse Laplace transform. **C) Applications of Laplace transform to Differential equations:** -Ordinary differential equations with constant and variable coefficients, simultaneous differential equations, applications to mechanical and electrical systems. **(Reference 5: chapter 6)**
4,5,6	**State-space Representation:**-Definitions and reviews of Matrix elementary operations, solution of state-space equation (Homogenous and Non-homogenous), kinds of state-space representation (Diagonal and Canonical) forms, properties of exponential matrix, methods of solving exponential matrix (using Laplace inverse, Cayley-Hamilton theorem, and Sylvester criterion). **(Reference 5: chapter 8 and Reference 4: chapter 9)**
7,8	**Z-transform: - A)** Definition of the z-transform, z-transform of some elementary functions, some important properties of the z-transform, Initial and Final value theorems. **B) The Inverse z-transform: -**Definition of inverse z-transform, methods of finding inverse z-transform, some important properties of inverse z-transform, Methods of solving difference equations using inverse z-transform. **(Reference 6: chapter 2)**
9,10	**Discrete State-space Representation: -** Kinds of discrete state-space representation (Diagonal and Canonical) forms, solution of discrete state-space equation (Homogenous and Non-homogenous). **(Reference 6: chapter 5)**

11,12,13	**Numerical Solution of non-linear equations:** -Newton-Raphson method, Lagrange interpolating polynomial, Euler's method, Modified Euler's method, second and fourth order Runge-kutta methods, numerical solution of non-linear equations and system of equations, least square error problems, Lievenberg marquardt algorithm, computer algorithmic design of numerical approaches. **(Reference 5: chapter 19)**
14,15,16	**Complex Variable theory: - A) Introduction: -**The complex number system, polar form of complex number, operations in polar form, Taylor's series. **B) Fourier Series and Integrals: -**Definition of Fourier series, odd and even functions, half range Fourier sin and cosine, complex form of Fourier series, the convolution theorem, relationship of Fourier and Laplace transforms. **(Reference 5: chapter 11 and chapter 13)**

Teaching Method:

Lectures, tutorials, problem solving, modeling, and self-studies.

Grade Distribution	
Mid Examination	**30 %**
Assignments, study cases	**30 %**
Final Exam	**40 %**

References:

1. **Engineering Mathematics for engineering by Anthony Croft et al., 4th edition 2012.**
2. **Advanced Modern Engineering Mathematics by Glyn James et al. 2010.**
3. **Advanced Engineering Mathematics by Dennis G. and Warren S., 4th edition 2009**
4. **Modern Control Engineering by Katsuhiko Ogata 5th edition 2011.**
5. **Advanced Engineering Mathematics by Erwin Kreyszig, 9th edition 2006.**
6. **Discrete-time Control Systems by Katsuhiko Ogata, 2nd edition 2009.**