Philadelphia University
Department of Basic Sciences and Mathematics

First Semester | Course Syllabus | 2014/2015

Course Title	Advanced Applied Mathematics
Course Code	250473
Lecturer	Feras Awad Mahmoud
Office Room	822 (Ext. 2132)
Office Hours	STT: 13:10 − 14:10 and MW: 11:15 − 14:15
E−mail	fawad@philadelphia.edu.jo
Webpage	http://www.philadelphia.edu.jo/academics/fawad/

Course Description

This course is particularly intended for the students who want to develop a basic competence in many areas of applied mathematics. The course covers many of important subjects. The student will deal with new functions and formulas like Gamma, Beta, Error functions, Stirling's formula, Elliptic integrals and functions, Legendre polynomials, Bessel functions and orthogonal functions.

Topics by the Week

Weeks	Topics
1 − 5	**Applications of the Definite Integral in Geometry, Science, and Engineering.** Area Between Two Curves. Volumes by Slicing; Disks and Washers. Volumes by Cylindrical Shells. Length of a Plane Curve. Area of a Surface of Revolution. Work. Moments, Centers of Gravity, and Centroids. Fluid Pressure and Force. Hyperbolic Functions and Hanging Cables.
6 − 9	**Special Functions.** Introduction. The Factorial Function. Definition of the Gamma Function; Recursion Relation. The Gamma Function of Negative Numbers. Some Important Formulas Involving Gamma Functions. Beta Functions. Beta Functions in Terms of Gamma Functions. The Simple Pendulum. The Error Function. Asymptotic Series. Stirling's Formula. Elliptic Integrals and Functions. Miscellaneous Problems.
10 − 16	**Series Solutions of Differential Equations; Legendre, Bessel, Hermite, and Laguerre Functions.** Introduction. Legendre's Equation. Leibniz' Rule for Differentiating Products. Rodrigues' Formula. Generating Function for Legendre Polynomials. Complete Sets of Orthogonal Functions. Orthogonality of the Legendre Polynomials. Normalization of the Legendre Polynomials. Legendre Series. The Associated Legendre Functions. Generalized Power Series or the Method of Frobenius. Bessel's Equation. The Second Solution of Bessel's Equation. Graphs and Zeros of Bessel Functions. Recursion Relations. Differential Equations with Bessel Function Solutions. Other Kinds of Bessel Functions. The Lengthening Pendulum. Orthogonality of Bessel Functions. Approximate Formulas for Bessel Functions. Series Solutions; Fuchs's Theorem. Hermite Functions; Laguerre Functions; Ladder Operators. Miscellaneous Problems.

Course Objectives Upon completion of the course, the student will be able to:

- Understand the basic use for both the Gamma and Beta functions.
- Solve the Legendre differential equation by series method and find the conditions necessary for a polynomial solution.
- Derive and apply the generating function and recurrence relations for Legendre Polynomials.
- Employ the orthogonality relation of Legendre polynomials to develop functions as series of such polynomials.

Learning Outcomes

- To give the student the necessary information to deals with problems that could be a model for some physical and biological problems.
- To give the student the necessary mathematical tools for further study in applied mathematics, where the Gamma function could be used in fractional calculus.
- To demonstrate the ability to use orthogonal functions (Legendre, Hermite, others) in approximating D.E, or expanding functions.

Assessment Distribution

Students will be assessed based on a 100 total marks, which are distributed as follows.

Exam Type	Expected Time	Points Allocated
First	Sun. 16/11/2014	20%
Second	Tue. 23/12/2014	20%
Homeworks	3 at least	20%
Final	(01−09)/02/2015	40%

Textbook and Supporting Materials

− Mary L. Boas, **Mathematical Methods in the Physical Sciences, 3rd Edition**, John Wiley & Sons 2006. Call number in PU library: 510 BOA.

− J. Ray Hanna and John H. Roland, **Fourier Series; Transforms; and Boundary Value Problems, 2nd Edition**, Dover Publications 2008. Call number in PU library: 515.35 HAN.