Detailed Course Description - Course Plan Development and Updating Procedures/ Mathematics Department	QF01/0408-3.0E

Faculty	Faculty of Science and Information Technology	Department	Mathematics
Course number	**0101455**	Course title	**دوال خاصة** **Special Functions**
Number of credit hours	3	Pre-requisite/co-requisite	Ordinary Differential Equations (1) 0101273

Brief course description
Frobinius method, Gamma and beta functions, Legendre polynomials and functions, Orthogonal functions and polynomials. Bessel's equation and its solutions, the Laplace Transform and its Use in Solving Differential Equations.

Course goals and learning outcomes	
Goal 1	Introduce the Power Series solution technique to Ordinary Differential Equations
Learning outcomes	Students will be able to: 1.1 Use power series methods to solve differential equations about ordinary points. 1.2 Use the Method of Frobenius to solve differential equations about regular singular points.
Goal 2	Expose the student to some special functions fundamental to engineering specifically Gamma, Beta, Bessel and Legendre
Learning outcomes	Students will be able to: 2.1 Understand purpose and functions of the gamma and beta functions. 2.2 Use the gamma function, beta function and special functions to: evaluate different types of integral calculus problems. 2.3 Solve a Boundary Value problem using Bessel and Legendre functions.
Goal 3	Learn to Compute the Laplace transform of a function and to use Laplace transform methods to solve differential equations.
Learning outcomes	Students will be able to: 3.1. Use shift theorems to compute the Laplace transform and inverse Laplace transform of functions. 3.2 Use the Laplace transform to compute solutions of second order, linear equations with constant coefficients. 3.3 Use the method of Laplace transforms to solve initial-value problems for linear differential equations with constant coefficients.

Textbook	1. "Special Functions for Scientists and Engineers". By W.W. Bell , Dover Publications, 2004. 2. "Special Functions for Scientists and Engineers". By; N. M. Laham and A. K. Abdullah. Yarmouk University, Irbid, Jordan 1996.
Supplementary references	1) "Orthogonal Functions" By G. Sansone, Dover, New York, 1991.

	2) "Special Functions and Orthogonal Polynomials". By Tu Diego Dominici, Robert S. Maier Tucson, Arizona.
	3) "Fourier series and Orthogonal Functions". By: Harry F. Davis, Allyn and Bacon 1989.
	4) Special Functions: An Introduction to the Classical Functions of Mathematical Physics, Nico M. Temme, John Wiley & Sons, 1996, ISBN: 0471113131.

Course timeline			
Week	**Number of hours**	**Course topics**	**Pages (textbook)**
01	**1** **1** **1**	Review of power series. Series solution of ordinary differential equation about an ordinary point Classification of ordinary and singular points	7 – 34
02	**1** **1** **1**	Solution around regular singular point-Frobinius method Solution around regular singular point, part I. Solution around regular singular point, part II.	35 – 44
03	**1** **1** **1**	Solution around regular singular point, repeated roots. Definitions of factorial function. Definitions of Gamma and Beta functions	45 – 64 85 – 88
04	**1** **1** **1**	Properties of the Gamma and Beta functions Relations between Gamma and Beta functions. Definitions of the Gamma function for negative values of the argument.	89 – 108
05	**1** **1** **1**	Legendre's equation and its solution. Legendre polynomials and functions. Generating function for the Legendre polynomials.	213 – 223
06	**1** **1** **1**	Further expressions for the Legendre polynomials. Explicit expressions for and special values of the Legendre polynomials. Orthogonally properties of the Legendre polynomials.	224 – 230
07	**1** **1** **1**	**First Exam 20%** Legendre series. Relations between the Legendre polynomials and their derivatives; recurrence relations.	231 – 248
08	**1** **1** **1**	Associated Legendere functions, properties of the associated Legendere functions. Legendere functions of the second kind. Spherical harmonics, graphs of Legendere functions.	249 – 276
09	**1** **1** **1**	Bessel's equation and its solutions; Bessel's functions of the first and second kind. Generating function for the Bessel's functions. Integral representations for Bessel's functions.	143 – 158
10	**1**	Recurrence relations.	159 – 184

	1 1	Hankel functions. Equations reducible to Bessel's equation.	
11	1 1 1	Modified Bessel's functions. Recurrence relations for the modified Bessel's functions. Kelvin's functions	185 - 197
12	1 1 1	Spherical of the Bessel function. **Second Exam. 20%** Orthonormality of the Bessel's functions; Bessel's series.	197 – 211
13	1 1 1	State the definition of the Laplace transform, and use the definition to calculate the transform of a simple function. Solution of initial value problems. Transform of Unit Step functions.	259 – 266
14	1 1 1	Transform of periodic function. Inverse of the Laplace Transform. Translation theorems.	267 - 305
15	1 1 1	Differentiation of the Laplace Transform. A Convolution Theorem. Applications of the Laplace transform.	
16	2	Review of the course. Final Exam. **50%**	-

Theoretical course evaluation methods and weight	Participation = 10% First exam 20% Second exam 20% Final exam 50%	**Practical (clinical) course evaluation methods**	Semester students' work = 50% (Reports, research, quizzes, etc.) Final exam = 50%

Approved by head of department		**Date of approval**	

Extra information (to be updated every semester by corresponding faculty member)

Name of teacher	**Amjed Zraiqat**	**Office Number**	**9356**
Phone number (extension)		**Email**	amjed@zuj.edu.jo
Office hours	**Sun., Tue., Thu. : 9:00 – 10:00** **Mon., Wed. : 11:0 – 12:30**		