QF01/0408-4.0E	Course Plan for Bachelor program - Study Plan Development and Updating Procedures/ Department of Mathematics

Study plan No.	**2021/2022**		**University Specialization**	**Bachelor of Mathematics**	
Course No.	**0101455**		**Course name**	**Special Functions**	
Credit Hours	**3**		**Prerequisite/ Co-requisite**	**Ordinary Differential Equations (1)**	
Course type	☐ MANDATORY UNIVERSITY REQUIREMENT	☐ UNIVERSITY ELECTIVE REQUIREMENTS	☐FACULTY MANDATORY REQUIREMENT	☐ Support course family requirements	☐ Mandatory requirements ✓ **Elective requirements**
Teaching style	☐ Full online learning		✓ **Blended learning**	☐ Traditional learning	
Teaching model	☐ 1 Synchronous: 1 asynchronous		✓ **1 face to face : 1 asynchronous**	☐ 2 Traditional	

Faculty member and study divisions' information (to be filled in each semester by the subject instructor)

Name	Academic rank	Office No.	Phone No.	E-mail	
Division number	**Time**	**Place**	**Number of students**	**Teaching style**	**Approved model**
				Blended	

Brief description

Frobinius method, Gamma and beta functions, Legendre polynomials functions and polynomials, Bessel's equation.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	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.			
Supportive learning resources (Books, databases, periodicals, software, applications, others)	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.			
Supporting websites	1. http://ocw.mit.edu/courses/mathematics/ 2. https://www.youtube.com/watch?v=arsdQdwkvwI 3. https://www.youtube.com/watch?v=AIvhQVOSmGg			
The physical environment for teaching	✓ Class room	☐ labs	✓ Virtual educational platform	☐ Others
Necessary equipment				

and software	
Supporting people with special needs	
For technical support	

Course learning outcomes (S= *Skills, C= Competences K= Knowledge,)*

No.	Course learning outcomes	The associated program learning output code
	Knowledge	
K1	Introduce the Power Series solution technique to Ordinary Differential Equations	**MK1**
K2	Compute gamma and beta functions.	**MK2**
K3	Define the Bessel and Legendre functions.	**MK2**
	Skills	
S1	Apply the gamma function, beta function and special functions to: evaluate different types of integral calculus problems.	**MS1**
S2	Solve a Boundary Value problem using Bessel and Legendre functions.	**MS1**
	Competences	
C1	Cooperate to work effectively in the group assignments.	**MC1**
C2	Working independently, Team working, creative and inductive thinking.	**MC1**

Mechanisms for direct evaluation of learning outcomes

Type of assessment / learning style	Fully electronic learning	Blended learning	Traditional Learning (Theory Learning)	Traditional Learning (Practical Learning)
Midterm exam	30%	**30%**	40%	30%
Participation / practical applications	0	**0**	10%	30%
Asynchronous interactive activities	30%	**20%**	0	0
Final exam	40%	**50%**	50%	40%

Schedule of simultaneous / face-to-face encounters and their topics

Week	Subject	learning style	Reference
1	Review of power series. Series solution of ordinary differential equation about an ordinary point. Classification of ordinary and singular points	Lecture	7 – 34
2	Solution around regular singular point-Frobinius method Solution around regular singular point, part I. Solution around regular singular point, part II.	Lecture	35 – 44
3	Solution around regular singular point, repeated roots. Definitions of factorial function. Definitions of Gamma and Beta functions	Lecture	45 – 64 85 – 88

4	Properties of the Gamma and Beta functions Relations between Gamma and Beta functions. Definitions of the Gamma function for negative values of the argument.	Lecture	89 – 108
5	Legendre's equation and its solution. Legendre polynomials and functions. Generating function for the Legendre polynomials.	Lecture	213 – 223
6	Further expressions for the Legendre polynomials. Explicit expressions for and special values of the Legendre polynomials. Orthogonally properties of the Legendre polynomials.	Lecture	224 – 230
7	Legendre series. Relations between the Legendre polynomials and their derivatives; recurrence relations.	Lecture	231 – 248
8	Associated Legendere functions, properties of the associated Legendere functions. Legendere functions of the second kind. Spherical harmonics, graphs of Legendere functions. **Midterm Exam 30%**	Lecture	249 – 276
9	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.	Lecture	143 – 158
10	Recurrence relations. Hankel functions. Equations reducible to Bessel's equation.	Lecture	159 – 184
11	Modified Bessel's functions. Recurrence relations for the modified Bessel's functions. Kelvin's functions	Lecture	185 - 197
12	Spherical of the Bessel function. Orthonormality of the Bessel's functions; Bessel's series.	Lecture	197 – 211
13	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.	Lecture	259 – 266
14	Transform of periodic function. Inverse of the Laplace Transform. Translation theorems.	Lecture	267 - 305
15	Differentiation of the Laplace Transform. A Convolution Theorem. Applications of the Laplace transform.	Lecture	267 - 305
16	**Final Exam 40%**		-

Schedule of asynchronous interactive activities (in the case of e-learning and blended learning)

Week	Task / activity	Reference	Expected results
1	Background	Ordinary differential equations Power Series	Self-reading and Discussion
2	Video 1 Solving exercises	E-learning	Discussion in the class
3	Homework 1:	(Lecture notes and Ref.1)	Submit a pdf or word sheet
4	Quiz 1	On the subjects studied on the first three weeks	Submitting on the E-learning
5	Assignment 1:	Internet sources and the other	Presentation

		Supportive learning resources	
6	Video 2	Solving exercises	Discussion in the class
7	Homework 2:	(Lecture notes and Ref.1)	Submit a pdf or word sheet
8	Assignment 2:	Internet sources and the other Supportive learning resources	Submitted with the mid exam
9	Self-reading	Power series. Series solution of ordinary differential equations.	Talk
10	Video3 Solving exercises	E-learning	Discussion in the class
11	Homework 3:	(Lecture notes and Ref.1)	Submit a pdf or word sheet
12	Self-reading	The Gamma function, Beta Function	Talk
13	Quiz 2	On the subjects studied on the subject studied after midexam	Submitting on the E-learning
14	Presentation of the subject:	Internet sources and the reference book	Video
15	Video 4 Revision of all the course	E-learning	Discussion in the class
16	**Final Exam**	-	