Philadelphia University	PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE	Approval date:
Faculty of Science		Issue:
Department of Math		Credit hours: 3
Academic year 2022/2023	Course Syllabus	Bachelor

Course information

Course#	Course title		Prerequisite	
250475	Special Functions		Real Analysis 1 250311	
Course type			Class time	Room #
☐ University Requirement ☐ Faculty Requirement ☒ Major Requirement ☒ Elective ☐ Compulsory			SMTWT 09:10-10:10	2827

Instructor Information

Name	Office No.	Phone No.	Office Hours	E-mail
Feras Awad	822	2132	SMTWT 10:15-11:15	fawad@philadelphia.edu.jo

Course Delivery Method

Course Delivery Method			
☐ Physical	☐ Online	☒ Blended	
Learning Model			
Precentage	Synchronous	Asynchronous	Physical
	0%	33%	67%

Course Description

Differentiation Of Integrals; Leibniz' Rule. 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. Stirling's Formula. Introduction; Series Solution of ODEs. 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. Introduction to Fractional Calculus.

Course Learning Outcomes

Number	Outcomes	Corresponding Program outcomes
Knowledge		
K1	Understand the basic properties of Gamma and Beta functions and how to use them in evaluating some integrals.	**K_p1**
K2	Learn how to extend function using orthogonal polynomials like Legendre polynomials.	**K_p3**
Skills		
S1	Handle mathematical calculations based on mathematical formulas and tricks.	**S_p2**
Competencies		
C1	Thinking reasonably and the ability to make decisions.	**C_p1**
C2	Work in a team to implement one of the tasks of the course.	**C_p2**

Learning Resources

Course textbook	• Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd Edition, John Wiley & Sons,. Inc 2006. **Call number in PU library: 510 BOA.**
Supporting References	• J. Ray Hanna and John H. Roland, Fourier Series; Transforms; and Boundary Value Problems,. 2nd Edition, John Wiley & Sons., Inc 1990. **Call number in PU library: 515.35 HAN.** • K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for physics and Engineering, 3rd Edition, Cambridge University Press 2002. **Call number in PU library: 515.1 RIL.**
Supporting websites	GeoGebra: www.geogebra.org
Teaching Environment	☒**Classroom** ☐ **laboratory** ☒**Learning platform** ☐**Other**

Meetings and Subjects Timetable

Week	Topic	Learning Methods	Tasks	Learning Material
1	Explanation of the study plan for the course, and what is expected to be accomplished by the students. Differentiation Of Integrals; Leibniz' Rule	Lecture	HW	Course Syllabus Chapter 4 Section 12
2	**Special Functions:** – The Factorial Function. – Definition of the Gamma Function; Recursion Relation. – The Gamma Function of Negative Numbers. – Some Important Formulas Involving Gamma Functions.	Lecture	Quiz	Chapter 11

3	– Beta Functions. – Beta Functions in Terms of Gamma Functions. – Stirling’s Formula.	Lecture	Quiz	Chapter 11
4	**Series Solutions of Differential Equations; Legendre, Bessel, Hermite, and Laguerre Functions:** – Introduction; Series Solution of ODEs. – Legendre’s Equation. – Leibniz’ Rule for Differentiating Products.	Lecture	HW	Chapter 12
5	– Rodrigues’ Formula. – Generating Function for Legendre Polynomials. – Complete Sets of Orthogonal Functions.	Lecture	HW	Chapter 12
6	– Orthogonality of the Legendre Polynomials. – Normalization of the Legendre Polynomials. – Legendre Series.	Lecture	Quiz	Chapter 12
7	**Introduction to Fractional Calculus.**	Lecture		Additional Papers
8	Final Exam			

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

Course Contributing to Learner Skill Development

Using Technology
• Use GeoGebra to do some calculations and graphics.
Communication Skills
• Choose a mathematical problem and present it to the students and explaining its solution method.
Application of Concepts Learnt
• Choose a math problem about Special Functions on YouTube and solve it.

Assessment Methods and Grade Distribution

Assessment Methods	Grade Weight	Assessment Time (Week No.)	Link to Course Outcomes
Mid Term Exam	**30%**	**4**	**K1, K2**
Various Assessments *	**30%**	**Continuous**	**S1, C1, C2**
Final Exam	**40%**	**6**	**K1, K2**
Total	**100%**		

* Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Alignment of Course Outcomes with Learning and Assessment Methods

Number	Learning Outcomes	Learning Method*	Assessment Method**
	Knowledge		
K1	Understand the basic properties of Gamma and Beta functions and how to use them in evaluating some integrals.	Lecture	**Exam**

K2	Learn how to extend function using orthogonal polynomials like Legendre polynomials.	Lecture	**Exam**
Skills			
S1	Handle mathematical calculations based on mathematical formulas and tricks.	Lecture	**HW**
Competencies			
C1	Thinking reasonably and the ability to make decisions.	Discussion	**Quiz**
C2	Work in a team to implement one of the tasks of the course.	Project	**Group Project**

* Includes: Lecture, flipped Class, project- based learning, problem solving based learning, collaborative learning

** Includes: quiz, in class and out of class assignment, presentations, reports, videotaped assignment, group or individual projects.

Course Polices

Policy	Policy Requirements
Passing Grade	The minimum passing grade for the course is (50%) and the minimum final mark recorded on transcript is (35%).
Missing Exams	• Missing an exam without a valid excuse will result in a zero grade to be assigned to the exam or assessment. • A Student who misses an exam or scheduled assessment, for a legitimate reason, must submit an official written excuse within a week from an exam or assessment due date. • A student who has an excuse for missing a final exam should submit the excuse to the dean within three days of the missed exam date.
Attendance	The student is not allowed to be absent more than (15%) of the total hours prescribed for the course, which equates to six lectures days (M, W) and six lectures (S, T). If the student misses more than (15%) of the total hours prescribed for the course without a satisfactory excuse accepted by the dean of the faculty, s/he will be prohibited from taking the final exam and the grade in that course is considered (zero), but if the absence is due to illness or a compulsive excuse accepted by the dean of the college, then withdrawal grade will be recorded.
Academic Honesty	Philadelphia University pays special attention to the issue of academic integrity, and the penalties stipulated in the university's instructions are applied to those who are proven to have committed an act that violates academic integrity, such as: cheating, plagiarism (academic theft), collusion, and violating intellectual property rights.

Program Learning Outcomes to be Assessed in this Course.

Number	Learning Outcome	Course Title	Assessment Method	Target Performance level
K_p3	The use of mathematical and statistical methods and scientific research mechanisms to address applied problems	Special Functions	HW	100% of the students get 70% or more on the rubric

Description of Program Learning Outcome Assessment Method

Number	Detailed Description of Assessment
K_p3	The student is given a function, and expand it using a series of Legendre polynomials.

Assessment Rubric of the Program Learning Outcome

	0 Point	1 – 2 Points	3 Points	4 Points	5 Points
Understanding of Legendre Polynomials (5 marks)	No understanding demonstrated.	Limited understanding with major misconceptions.	Basic understanding of Legendre polynomials but with minor errors.	Good understanding with only minor gaps in knowledge.	Excellent understanding, demonstrating a comprehensive knowledge of Legendre polynomials.
Correctly Identifying the Function (5 marks)	No attempt to identify the given function.	Attempt made, but significant errors in identifying the function.	Partially correct identification with minor errors.	Mostly correct identification with minor gaps in reasoning.	Accurately and clearly identified the given function.
Deriving the Expansion Coefficients (5 marks)	No attempt to derive expansion coefficients.	Attempts made, but multiple mistakes and incorrect approach.	Partially correct derivation with some errors in calculations or understanding.	Mostly correct derivation with minor errors or omissions.	Accurately derived the expansion coefficients and demonstrated a solid understanding of the process.
Expanding the Function (5 marks)	No attempt to expand the function.	Attempted the expansion, but multiple mistakes and incorrect approach.	Partially correct expansion with some errors in calculations or understanding.	Mostly correct expansion with minor errors or omissions.	Accurately expanded the function using Legendre polynomials and demonstrated a solid understanding of the process.
Correctness of the Final Solution (5 marks)	Final solution is incorrect or not provided.	Major errors in the final solution.	Some errors, but overall correct approach.	Minor errors that do not significantly impact the final result.	Correct final solution, fully expanded using Legendre polynomials.
Clarity and Organization (5 marks)	The solution is incoherent, disorganized, or poorly presented.	The solution lacks clarity and has significant organizational issues.	Some clarity and organization, but improvements are needed.	Mostly clear and organized solution, with only minor issues.	Clear, well-structured, and easy-to-follow solution.