Philadelphia University	PHILADELPHIA UNIVERSITY THE WAY TO THE FUTURE	**Approval date:**
Faculty of Science		**Issue:**
Department of Math		**Credit hours: 3**
Academic year 2023/2024	**Course Syllabus**	**Bachelor**

Course information

Course#	Course title	Prerequisite
250371	**Numerical Analysis**	**ODE 250203**

Course type	Class time	Room #
☐ University Requirement ☐ Faculty Requirement ☒ Major Requirement ☐ Elective ☒ Compulsory	SSMTW 10:20-11:20	21005

Instructor Information

Name	Office No.	Phone No.	Office Hours	E-mail
Feras Awad	822	2132	SSMTW 11:30-12:30	fawad@philadelphia.edu.jo

Course Delivery Method

Course Delivery Method			
☒ **Physical**	☐ **Online**	☐ **Blended**	
Learning Model			
Precentage	**Synchronous**	**Asynchronous**	**Physical**
	0%	**0%**	**100%**

Course Description

This course introduces fundamental numerical methods for solving mathematical problems. Emphasizing both theoretical foundations and practical implementation, students will explore numerical techniques for solving equations, interpolating data, approximating functions, integrating functions, solving ordinary differential equations, and more.

Course Learning Outcomes

Number	Outcomes	Corresponding Program outcomes
	Knowledge	
K1	Identify and describe different numerical methods and algorithms for solving equations, interpolating data, approximating functions, integrating functions, solving ordinary differential equations, and solving linear systems of equations.	**K_p1**
K2	Explain the sources of error in numerical computations and evaluate the accuracy of numerical solutions.	**K_p1**
	Skills	
S1	Implement numerical algorithms using computational tools or programming languages to solve mathematical problems.	**S_p4**
S2	Apply appropriate numerical techniques to solve practical problems in science and engineering.	**S_p2**

Competencies		
C1	Communicate effectively, both orally and in writing, about numerical analysis concepts, techniques, and results.	**C_p1**
C2	Work collaboratively in teams to solve numerical problems and present findings.	**C_p2**

Learning Resources

Course textbook	Richard L. Johnson and Douglas J. Faires. (2011) Numerical Analysis. (9th ed.). Brooks / Cole.
Supporting References	• Ward Cheney and David Kincaid. (2004) Numerical mathematics and computing. (5th ed.). Brooks / Cole. • John H. Mathews and Kurtis D. Fink. (2004) Numerical methods using MATLAB. (4th ed.). Prentice Hall.
Supporting websites	• Companion Website: https://sites.google.com/site/numericalanalysis1burden/ • Geogebra: https://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. **Mathematical Preliminaries & Error Analysis** 1.1 Review of Calculus (Taylor Polynomial) 1.2 Round-off Errors and Computer Arithmetic	Lecture		Course Syllabus Chapter 1
2	**Solutions of Equations in One Variable** 2.1 The Bisection Method 2.2 Fixed-Point Iteration	Lecture	Quiz	Chapter 2
3	2.3 Newton's Method and Its Extensions **Interpolation and Polynomial Approximation** 3.1 Interpolation and the Lagrange Polynomial	Lecture	Quiz	Chapter 2 Chapter 3
4	3.2 Data Approximation and Neville's Method 3.3 Divided Differences	Lecture	Midterm	Chapter 3
5	**Numerical Differentiation and Integration** 4.1 Numerical Differentiation 4.3 Elements of Numerical Integration 4.4 Composite Numerical Integration	Lecture		Chapter 4
6	**Initial-Value Problems for ODEs** 5.1 The Elementary Theory of IVPs 5.2 Euler's Method 5.3 Higher-Order Taylor Methods 5.4 Runge-Kutta Methods	Lecture		Chapter 5
7	**Iterative Techniques in Matrix Algebra** 7.1 Norms of Vectors and Matrices 7.2 Eigenvalues and Eigenvectors 7.3 The Jacobi and Gauss-Siedel Iterative Techniques	Lecture	Quiz	Chapter 7
8	Final Exam			

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

Self-Review Exercises

Chapter	Section	Exercises
1	**1**	8, 9, 19
	2	1(c, d, g), 2(a, b, c, d), 5(e, f), 19(a)
2	**1**	1, 2, 5(b), 6(c), 11, 13, 16, 18
	2	1(a, d), 2(a, b), 5, 8, 9, 16, 17
	3	1, 2, 4a
3	**1**	1(a, b), 6(a), 8(a), 9, 13(a)
	2	3(a, b, c), 4, 5, 6, 7, 8, 9
	3	4(a, b), 7(a, b), 9(a), 10, 13, 17
4	**1**	2(a), 4(a), 18(a)
	3	1(a), 3(a), 5(a), 7(a), 9(a), 11(a), 13, 14, 15, 17, 18, 19.
	4	1, 3, 5, 7, 9, 10, 13
5	**1**	1, 2, 3, 5, 9
	2	1, 2, 3, 9
	3	1, 2, 3, 4, 10
	4	1, 2, 6, 10, 14, 30, 31
7	**1**	1, 3, 5, 7, 9
	2	1, 5, 7, 9, 11, 16
	3	1, 3, 5, 7, 9
	4	1, 3, 5, 7, 9

Course Contributing to Learner Skill Development

Using Technology
• Utilize interactive simulations and visualization tools (e.g. Geogebra) to help students develop a deeper understanding of numerical concepts and algorithms. • Integrate the use of computational tools and software such as Excel, Python with NumPy and SciPy libraries, or Mathematica to implement numerical algorithms and solve mathematical problems.
Communication Skills
• Encourage students to engage in peer discussions, group work, and online forums to exchange ideas, collaborate, and articulate mathematical solutions effectively.
Application of Concepts Learnt
• Assign problem-solving projects that require students to apply numerical methods concepts to novel problems and situations, helping them develop problem-solving and critical thinking skills.

Assessment Methods and Grade Distribution

Assessment Methods	Grade Weight	Assessment Time (Week No.)	Link to Course Outcomes
Mid Term Exam	**30%**	**8**	**K1, K2**
Various Assessments *	**30%**	**Continuous**	**S1, S2, C1, C2**
Final Exam	**40%**	**16**	**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	Identify and describe different numerical methods and algorithms for solving equations, interpolating data, approximating functions, integrating functions, solving ordinary differential equations, and solving linear systems of equations.	Lecture	**Exam**
K2	Explain the sources of error in numerical computations and evaluate the accuracy of numerical solutions.	Lecture	**Exam**
Skills			
S1	Implement numerical algorithms using computational tools or programming languages to solve mathematical problems.	Project	**Quiz**
S2	Apply appropriate numerical techniques to solve practical problems in science and engineering.	Problem Solving	**Quiz**
Competencies			
C1	Communicate effectively, both orally and in writing, about numerical analysis concepts, techniques, and results.	Problem Solving	**Homework**
C2	Work collaboratively in teams to solve numerical problems and present findings.	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 seven lectures (S, T, 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
S_p2	The ability to apply mathematics in various real-life situations.	Numerical Analysis	Quiz	100% of the students get 80% or more on the rubric

Description of Program Learning Outcome Assessment Method

Number	Detailed Description of Assessment
S_p2	Students will select a real-life problem or scenario that requires numerical analysis for its solution. Then they will apply numerical methods and techniques learned in the course to solve the formulated mathematical model.

Assessment Rubric of the Program Learning Outcome

	Excellent (4 pts**)** Student understands the concept perfectly.	**Good (**3 pts**)** Student is almost perfect in their understanding of the topic, with some minor confusion or mistakes.	**Fair (**2 pts**)** Student has a decent grasp of the process but makes some major mistakes.	**Poor (**1 pt.**)** Student is very confused and does not understand the topic, nor is able to clearly grasp how to apply it or when to use it.
Problem Identification and Relevance	The problem is clearly identified with significant real-world relevance. The chosen problem demonstrates a deep understanding of its context and importance.	The problem is adequately identified with some real-world relevance. The chosen problem demonstrates a good understanding of its context and importance.	The problem identification lacks clarity or relevance to real-world situations. The chosen problem demonstrates a limited understanding of its context and importance.	The problem identification is unclear or irrelevant to real-world situations.
Mathematical Modeling	The mathematical model is sophisticated, accurately representing the real-life problem with appropriate equations and assumptions. The model demonstrates a deep understanding of the underlying mathematics.	The mathematical model is accurate, representing the real-life problem with appropriate equations and assumptions. The model demonstrates a good understanding of the underlying mathematics.	The mathematical model is somewhat accurate but lacks precision in representing the real-life problem. The model demonstrates a limited understanding of the underlying mathematics.	The mathematical model is inaccurate or incomplete in representing the real-life problem.
Numerical Analysis Techniques	A variety of advanced numerical techniques are correctly applied, demonstrating a deep understanding of their theoretical foundations and practical implementation.	Basic and intermediate numerical techniques are correctly applied, demonstrating a good understanding of their theoretical foundations and practical implementation.	Numerical techniques are attempted but with some errors or inaccuracies, indicating a limited understanding of their theoretical foundations and practical implementation.	Numerical techniques are not applied or are applied incorrectly.
Analysis and Interpretation	Results are thoroughly analyzed and interpreted with insightful conclusions drawn from the numerical solutions. The analysis demonstrates a deep understanding of the implications of the results.	Results are adequately analyzed and interpreted with logical conclusions drawn from the numerical solutions. The analysis demonstrates a good understanding of the implications of the results.	Results are analyzed but with limited depth or clarity in interpretation. The analysis demonstrates a basic understanding of the implications of the results.	Not Evident: Results are not analyzed or interpreted.