

## Course E-Syllabus

1	<b>Course title</b>	Numerical Analysis
2	<b>Course number</b>	1901351
3	<b>Credit hours</b>	3
	<b>Contact hours (theory, practical)</b>	3
4	<b>Prerequisites/corequisites</b>	Computer Skills for Scientific Faculties (1931102)+ Calculus-1 (0301101)
5	<b>Program title</b>	Computer Science
6	<b>Program code</b>	01
7	<b>Awarding institution</b>	The University of Jordan
8	<b>School</b>	King Abdullah II School for Information Technology
9	<b>Department</b>	Computer Science
10	<b>Level of course</b>	Third year
11	<b>Year of study and semester (s)</b>	Third year, First 2022/2023
12	<b>Final Qualification</b>	Bachelor of CS
13	<b>Other department (s) involved in teaching the course</b>	
14	<b>Language of Instruction</b>	English
15	<b>Teaching methodology</b>	<input type="checkbox"/> Blended <input type="checkbox"/> Online <input checked="" type="checkbox"/> Face to Face
16	<b>Electronic platform(s)</b>	<input checked="" type="checkbox"/> Moodle <input checked="" type="checkbox"/> Microsoft Teams <input type="checkbox"/> Skype <input type="checkbox"/> Zoom <input type="checkbox"/> Others.....
17	<b>Date of production/revision</b>	

### 18 Course Coordinator:

Name: **Prof. Ahmad Sharieh, PhD** Office number:  
 Department Office Phone Number: 06-5355000 ext. 22591  
 Office Location: KASIT First Floor -105  
 Office Hours: Monday, Wednesday 12:00 -1:00, or by appointment  
 Tuesday, Thursday 11:00 – 12:00

E-mail: [sharieh@ju.edu.jo](mailto:sharieh@ju.edu.jo)

### 19 Other instructors:

### 20 Course Description:

**As stated in the approved study plan.**

The course is basic course in numerical methods. It introduces students to: Error analysis; Finding roots of a function: bracketing and iterative methods; Roots: direct and indirect solution of systems of linear equations; Solution of nonlinear systems; Approximation and interpolation; Numerical integration and differentiation; Programming language programs in parallel with material or using MATLAB . Weekly practice in the lab.

**21 Course aims and outcomes:**

**A- The Goal:** The main goal of this course is to enable students to understand, develop, analyze approximate solutions to algebraic, transcendental, differential equations, derivatives, integral, and hard problems; and implement the solutions using software such as MATLAB.

**ABET: The main Students Outcome as in ABET:**

- 1- Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- 2- Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- 3- Apply computer science theory and software development fundamentals to produce computing-based solutions.

**Course Objectives:** Enable students to

1. Perform an error analysis for various numerical methods
2. Deploy various numerical root finding methods
3. Develop appropriate numerical methods to approximate functions
4. Derive appropriate numerical methods to solve algebraic and transcendental equations
5. Develop appropriate numerical methods to interpolate functions.
6. Derive appropriate numerical methods to evaluate a derivative at a value
7. Derive appropriate numerical methods to solve a linear system of equations
8. Derive appropriate numerical methods to calculate a definite integral
9. Code various numerical methods in a modern computer language using MATLAB, for example.

**B - Intended Learning Outcomes(ILOs):**

Successful completion of this course should enable a student to gain the following knowledge and skills:

**A- Knowledge and Understanding:**

- A1) Understand the basic error analysis techniques.
- A2) Understand the basic methods for root approximation.
- A3) Understand the basic methods for solving linear systems.
- A4) Understand the basic numerical techniques for approximating differentiation.
- A5) Understand the basic numerical techniques for approximating integration
- A6) Understand the basic numerical techniques for interpolation

**B- Cognitive and Intellectual skills:**

- B1) Analyze and compare the significance of the different techniques for root approximation.
- B2) Analyze and compare the different techniques for solving linear systems.
- B3) analyze and compare the different techniques for numerical differentiation.
- B4) analyze and compare the different techniques for numerical integration.
- B5) Prove results for numerical root finding methods.

**C- Subject Specific Skills:**

- C1) Compute the absolute, relative, rounding, truncation, and propagation errors.
- C2) Solve an algebraic or transcendental equation using an appropriate numerical method.
- C3) Solve differential equations using an appropriate numerical method.
- C4) Calculate a definite integral using an appropriate numerical method.
- C5) Solve real world problems numerically using MATLAB.

**D- Transferable Skills:**

- D1) ) Perform an error analysis for a given numerical method
- D2) Discuss and work in a group in order to solve numerical approximation problems.
- D3) Discuss and work in a group in order to program numerical solutions using MATLAB.
- D4) Demonstrate developed solutions using programming language.

## 22. Topic Outline and Schedule:

Week	Lecture	Topic	Teaching Methods*/platform	Evaluation Methods**	References
1	1.1	Why Numerical Analysis	Lecture (Synchronous SY)/ Teams		Text Book
	1.2	Error	Lecture Asynchronous AS/Teams		Chapter 3 (3.3.)
	1.3	Significant digits	Lecture AS+SY /Teams	Homework 1	Chapter 3 (3.4)
2	2.1	MATLAB: Introduction	Using MATLAB/Lab		MATLAB User Manual
	2.2	MATLAB: Loop	Using MATLAB/Lab		MATLAB User Manual
	2.3	MATLAB practice	Using MATLAB/Lab		MATLAB User Manual
3	3.1	Bracketing Methods for Solving non-Linear function: Bisection Method	Lecture AS+SY/ Teams		Chapter 5: 5.1, 5.2)
	3.2	False Position Method	Lecture AS+SY/ Teams	Homework 2	Chapter 5: 5.2.2, 5.3)
	3.3	MATLAB	Using MATLAB/Lab	MATLAB Assignment 1	MATLAB User Manual/ On function
4	4.1	Open Methods: Fixed point Iteration	Lecture AS+SY/ Teams		Chapter 6: 1, 6.1.1, 6.1.2)
	4.2	Newton-Raphson Method	Lecture AS+SY/ Teams		Chapter 6: 6.2, 6.2.3, 6.3)
	4.3	Secant Method	Lecture AS+SY/ Teams	Homework 3	Chapter 6: 6.6).
5	5.1	Solution of system on linear equations: By graph	Lecture AS+SY/ Teams		Chapter 9: 9.1,
	5.2	Matrices Operations: Review +By Cramer's Rule and Inverse of coefficient Matrix	Lecture AS+SY/ Teams		Chapter 9: 9.1.1
	5.3				Chapter 9: 9.1.3,
6	6.1	Row Simple Operations	Lecture AS+SY/ Teams		Chapter 9: 9.3, 9.3.4

	6.2	Gauss Elimination	Lecture AS+SY/ Teams		Chapter 9: 9.3, 9.3.4
	6.3	Solving System of Linear equations using Gauss Elimination method	Lecture AS+SY/ Teams		Chapter 9:, 9.3.4
7	7.1	Gauss-Jordan	Lecture AS+SY/ Teams	Homework 4	Chapter 9:, 9.3.4
	7.2	MATLAB: Matrices and arrays	Using MATLAB/Lab	MATLAB Assignment 2	MATLAB User Manual/ On functions
	7.3	Review	Lecture/Team		Text Book(Ch9)+ Presentation
8	8.1	Midterm Exam	JUExam		
	8.2	LU-Factorization (Decomposition)	Lecture AS+SY/ Teams		Chapter 10: 10.1, 10.1.1, 1.1.2,
	8.3	Solving System of Linear equations using LU-Factorization	Lecture AS+SY/ Teams		Chapter 10: 10.1.3
9	9.1	Solving System of Linear equations: Iteration Methods	Lecture AS+SY/ Teams	Homework 5	Chapter 11: 11.2
	9.2	Review Midterm Results	Lecture AS+SY/ Teams		
	9.3	MATLAB: Solving system of linear equations	Lecture AS+SY/ Teams	MATLAB Assignment 3	On System of linear equations
10	10.1	Curve Fitting: Least Square line	Lecture AS+SY/ Teams		Chapter 17 : 17.1.2
	10.2	Curve Fitting: Linearization	Lecture AS+SY/ Teams	Homework 6	Chapter 17 : 17.15
	10.3	Interpolation: Taylor Series	Lecture AS+SY/ Teams		Chapter 18: 18.1,18.1.1
11	11.1	Lagrange Polynomial Interpolation	Lecture AS+SY/ Teams		Chapter 18: 18.1.3
	11.2	Newton Polynomial	Lecture AS+SY/ Teams		Chapter 18:, 18.1.2
	11.3	Newton Divided Differences	Lecture AS+SY/ Teams		Chapter 18: 18.1.2
12	12.1	Line Spline	Lecture AS+SY/ Teams	Homework 7	Chapter 18: 18.1.5
	12.2	Review	Lecture AS+SY/ Teams		
	12.3	MATLAB: Loops	Using MATLAB/Lab	MATLAB Assignment 4	MATLAB User Manual /On interpolation with loops
13	13.1	MATLAB Test 1	Using MATLAB/Lab	Test 1	
	13.2	Differentiation	Lecture AS+SY/ Teams		Chapter 23: 23.1

	13.3	MATLAB: Drawing	Using MATLAB/Lab	MATLAB Assignment 5	
14	14.1	Integration: Trapezoidal Rule	Lecture AS+SY/ Teams		Chapter 21: 21.1, 21.1.1
	14.2	1/3 Simpson's Rule	Lecture AS+SY/ Teams		Chapter 21: 21.1.2
	14.3	Multiple Rules	Lecture AS+SY/ Teams		Chapter 21: 21.2.2, 21.2.3
15	15.1	3/8 Simpsons Rule	Lecture AS+SY/ Teams	Homework 8	
	15.2	MATLAB Test 2	Using MATLAB/Lab	Test 2	MATLAB User Manual
	15.3	Review	Lecture AS+SY/ Teams		

- Teaching methods include: Synchronous lecturing/meeting; Asynchronous lecturing/meeting
- Evaluation methods include: Homework, Quiz, Exam, pre-lab quiz...etc

### 23 Evaluation Methods:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	Period (Week)	Platform
Homework 1	2	Error	1	Moodle
Homework 2	2	Solving nonlinear function using Bracketing Methods	2	Moodle
MATLAB Assignment 1	2	Bisection Method	3	Moodle
Homework 3	2	Solving nonlinear function using open Methods	4	Moodle
Homework 4	2	Solving System of Linear equations: Gauss Elimination + Gauss-Jordan	5-6	Moodle
MATLAB Assignment 2	2	Newton-Raphson	7	Moodle
Midterm Exam	20	Error, function, Gauss elimination	8	JUExam
Homework 5	2	Solving System of Linear equations: Iteration Methods	9	Moodle
MATLAB Assignment 3	2	MATLAB: Solving system of linear equations	9	Moodle
Homework 6	2	Curve Fitting: Linearization	10	Moodle
Homework 7	2	Interpolation	11	Moodle
MATLAB Assignment 4	2	Interpolation	12	Moodle
MATLAB Test 1	5	Functions, system of linear equations	13	Lab
MATLAB Assignment 5	1	Drawing function surface	15	Moodle
Homework 8	2	Integration	15	Moodle
MATLAB Test 2	5	Plotting	15	Lab
Final EXAM	50		16	JUExam

## 24 Course Requirements (e.g: students should have a computer, internet connection, webcam, account on a specific software/platform...etc):

Students should have a computer, internet connection, webcam, account on a specific Microsoft Teams software/platform, and MATLAB software

## 25 Course Policies:

Please follow The University of Jordan regulations regarding the following policies, more information is at [www.ju.edu.jo](http://www.ju.edu.jo)

A- Attendance policies:

**Attendance will be recorded by the Microsoft Teams. See the UJ attendance policies.**

B- Absences from exams and submitting assignments on time

**Late assignment will not be accepted**

C- Health and safety procedures:

Follow the JU regulations and policies.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

If there is cheating or plagiarism in a home works and in a MATLAB assignment, both sources will be given 0.

E- Grading policy: Intended marks-grades

0-39	F	40-44	D-	45-49	D	50-54	D+	55-59	C-	60-64	C	65-70
	C+	71-79	B-	80-84	B	85-89	B+	90-93	A-	94-100	A	

The grade may be given based on the average of all marks out of 100%.

F- Available university services that support achievement in the course:

Lab with MATLAB and 20 to 40 desktops, Microsoft Teams plat form for lecturing, one laptop with multimedia, The webpage (<https://elearning.ju.edu.jo>) is a primary communication vehicle.

## 26 References:

A- Required book(s), assigned reading and audio-visuals:

A.1 Text Book: Stephen C. Chapra and Rymond P. Canale, Numerical Methods for Engineerins, Edition 8, Mc Craw Hill Education, 2018.

A.2 MATLAB USER MANUAL from Moler, Cleve B. (2004), Numerical Computing with Matlab, 2004, SIAM, Philadelphia, PA. It can be downloaded along with software from <http://www.mathworks.com/moler/>

Todd Young and Martin J. Mohlenkamp (2012), Introduction to Numerical Methods and Matlab Programming for Engineers, Department of Mathematics, Ohio University, Athens.

<http://www2.mansfield.edu/mathematics/program-course-goals-objectives-and-outcomes/index.cfm>

B- Recommended books, materials and media:

Todd Young and Martin J. Mohlenkamp (2012), Introduction to Numerical Methods and Matlab Programming for Engineers, Department of Mathematics, Ohio University, Athens.

<http://www2.mansfield.edu/mathematics/program-course-goals-objectives-and-outcomes/index.cfm>

**27 Additional information:**

Name of Course Coordinator: Ahmad Sharieh    Signature: -- *Ahmad Sharieh* ----    Date: --3/10/2021--

Head of Curriculum Committee/Department: -----    Signature: -----

Head of Department: -----    Signature: -----

Head of Curriculum Committee/Faculty: -----    Signature: -----

Dean: -----    Signature: -----