جامعة الإسراء
ISRA UNIVERSITY

Course Syllabus

According to JORDAN National Qualification Framework (JNQF)

Course Name: Numerical analysis methods

Course Number: 403205/4032213

General Course Information:

Course title	**Numerical analysis methods**
Course number	**403205/4032213**
Credit hours	**3**
Education type	**[Face-to-Face]**
Prerequisites/corequisites	**Engineering Mathmatics.**
Academic Program	**Civil engineering**
Program code	**03**
Faculty	**Engineering**
Department	**Civil engineering**
Level of course	**Third Year**
Academic year /semester	**First Semester 2022-2023**
Awarded qualification	**B.Sc**
Other department(s) involved in teaching the course	**-**
Language of instruction	**English**
Date of production/revision	**2022/2023**

Course Coordinator:

Coordinator's name	**Dr. Wissam Alkhadour**
Office No	**4207**
Office Phone extension number	
Office Hours	**Tue& Thur [12:00-1:00] , Mond& Wed.[11:00-1:00]**
Email	**Wesam.alkhadour@iu.edu.jo**

Other Instructors:

Instructor name	
Office No	
Office Phone extension number	
Office Hours	
Email	

Course Description *(English/Arabic)*:

English	Approximations and numerical errors, roots of equations, methods of solving linear and non linear equations, numerical integration, numerical differentiation, theory of curve fitting, the use of numerical techniques and computer to solve civil engineering (structural, hydraulics, environmental, transportation and geotechnical problems.
Arabic	التقريب والأخطاء العددية، جذور المعدلات، طرق حل المعادلات الخطية وغير الخطية، التكامل العددي، التفاضل العددي، نظرية مطابقة المنحنيات، التطبيقات واستخدام الحاسوب في مجالات الهندسة المدنية المختلفة.

Textbook: ***Author(s), Title, Publisher, Edition, Year, Book website.***

Numerical Methods for Engineers 8th Edition by Steven Chapra (Author), Raymond Canale 2015.
https://www.academia.edu/31722261/Numerical_Methods_for_Engineers_7th_Edition_steven_chapra

References: ***Author(s), Title, Publisher, Edition, Year, Book website.***

1. Advanced Engineering Mathematics, by H.C. Taneja, 0th Edition, Kindle Edition, 2013,
2. Numerical Methods, by Babu Ram, 2010.
3. Numerical methods in civil engineering, lecture notes by Janusz ORKISZ, 2007.

Course Educational Objectives (CEOs):

1.	**Understand the concept of numerical methods and the concept of error and approximation.**
2.	**Learn how to solve equation of one variable and a system of linear and non-linear equations using numerical methods.**
3.	**Learn Interpolation using different numerical methods**
4.	**Learn numerical differentiation & integration, Solve initial value problems (IVP) numerically.**

Intended Learning Outcomes (ILO's):

	Subject Intended learning outcomes (ILOs) describe what students are expected to know and be able to do at the end of the course. These outcomes are related to the knowledge, skill and competence that students acquire:	**Relationship to CEOs**	**Contribution to PLOs**	**Bloom Taxonomy Levels***	**Descriptors****
A	**Knowledge and Understanding:**				
A1	**The students will be able to explain the basic concepts of numerical methods and the importance of these methods in solving engineering problems, calculate errors.**	**1**	**1,7**	**1**	**K,C**
A2					
A3					
B	**Intellectual skills:**				
B1					
B2					
B3					
C	**Subject specific skills:**				
C1	**The students will be able to solve algebraic and transcendental equations of one variable using numerical methods.**	**2**	**1,7**	**3**	**K,C**
C2	**The students will be able to Solve linear and non-linear system of equations using numerical methods.**	**2**	**1,7**	**3**	**K,C**

C3	**The students will be able to use interpolation to solve mathematical problems numerically.**	**3**	**1,7**	**3**	**K,C**
C4	**The students will be able to use numerical integration and derivatives to find approximate solutions for some mathematical problems and initial value problem.**	**4**	**1,7**	**3**	**K,C**
D	**Transferable skills:**				
D1					
D2					
D3					

***Bloom Taxonomy Levels**

Level #	1	2	3	4	5	6
Level Name	Knowledge	Comprehension	Application	Analysis	Evaluation	Synthesis

**** Descriptor (National Qualification Framework Descriptors): K : Knowledge, S: Skill, C: Competency.**

Program Learning Outcome (PLOs):

Program Learning Outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviours that students acquire as they progress through the program. A graduate of the (CE) program will demonstrate:		Descriptors**		
		K	S	C
1.	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	K		
2.	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.			C
3.	An ability to communicate effectively with a range of audiences.		S	
4.	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.			C
5.	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.		S	
6.	An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions.		S	
7.	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	K		C

**** Descriptors according to the national qualifications framework (K: knowledge, S: skill, C: Competency)**

Weekly Schedule *(please choose the type of teaching)*

✓ **Face to Face**

□ **Hybrid** *(**2 Lectures** Face – To - Face **+1 Lecture** Asynchronous)*

□ **Hybrid (***1 Lectures* Face – To - Face ***+1 Lecture*** Asynchronous)

□ **Online** *(**2 Lectures** Synchronous **+1 lecture Asynchronous**)*

Week	First Hour (……)	Second Hour (……)	Third Hour (……)	Ach. ILOs	Ach. PLOs	Descriptors*
1	**Course syllabus, Introduction to numerical methods.**	**Importance of numerical methods in solving complex**	**Concept of errors, types of errors and approximation.**	**A1**	PLO1,7	K,C

	Difference between algebraic and numerical methods	**engineering problem.**				
2	**Solution of non-linear equation (bracketing methods): Bisection method**	**Solution of non-linear equation (bracketing methods): False position method**	**Solution of non-linear equation (bracketing methods): Solving more examples.**	**C1**	PLO1,7	K,C
3	**Solution of non-linear equation (non-bracketing methods): Secant method**	**Solution of non-linear equation (non-bracketing methods): Newton Raphson method**	**Solution of non-linear equation (non-bracketing methods): Solving more examples**	**C1**	PLO1,7	K,C
4	**Solution of linear system of equations: Lowe upper decomposition method.**	**Solution of linear system of equations: Lowe upper decomposition method.**	**Solution of linear system of equations: Lowe upper decomposition method.**	**C2**	PLO1,7	K,C
5	**Solution of linear system of equations: Gauss-Seidel method**	**Solution of linear system of equations: Gauss-Seidel method**	**Solution of linear system of equations: Gauss-Seidel method**	**C2**	PLO1,7	K,C
6	**Interpolation: Introduction to interpolation Direct method of interpolation (linear interpolation)**	**Interpolation: Direct method of interpolation (quadratic interpolation)**	**Interpolation: Direct method of interpolation (cubic interpolation)**	**C3**	PLO1,7	K,C
7	**Interpolation: Newton's Divided Difference Polynomial Method of Interpolation (linear interpolation)**	**Interpolation: Newton's Divided Difference Polynomial Method of Interpolation (quadratic interpolation)**	**Interpolation: Newton's Divided Difference Polynomial Method of Interpolation (cubic interpolation)**	**C3**	PLO1,7	K,C
8	**Interpolation: Lagrangian interpolation (linear interpolation)**	**Interpolation: Lagrangian interpolation (quadratic interpolation)**	**Interpolation: Lagrangian interpolation (cubic interpolation)**	C3	PLO1,7	K,C
9	**Numerical integration:**	**Numerical integration:**	**Numerical integration:**	C4	PLO1,7	K,C

	Trapezoidal method (Single application)	**Trapezoidal method (multiple segment application)**	**Trapezoidal method (multiple segment application)**			
10	**Numerical integration: h/3 Simpson's rule (Single application)**	**Numerical integration: h/3 Simpson's rule (multiple segment application)**	**Mid-Term Exam**	C4	PLO1,7	K,C
11	**Numerical integration: 3h/8 Simpson's rule (Single application)**	**Numerical integration: 3h/8 Simpson's rule (multiple segment application).**	**Numerical integration: 3h/8 Simpson's rule (multiple segment application).**	C4	PLO1,7	K,C
13	**Numerical integration: Gauss Quadrature rules of numerical integrations**	**Numerical integration: Gauss Quadrature rules of numerical integrations**	**Numerical integration: Gauss Quadrature rules of numerical integrations**	C4	PLO1,7	K,C
14	**Differential equation (Solving initial value problem) Simple Euller's method)**	**Differential equation (Solving initial value problem) Modfied Euller's method**	**Differential equation (Solving initial value problem) Modfied Euller's method**	C4	PLO1,7	K,C
15	**Differential equation (Solving initial value problem) Runge Kutta's method**	**Differential equation (Solving initial value problem) Runge Kutta's method**	**Differential equation (Solving initial value problem) Runge Kutta's method**	C4	PLO1,7	K,C
16	**Differential equation (Solving initial value problem) Runge Kutta's method**	**Differential equation (Solving initial value) Solving more examples**	**Final Exam**	C4	PLO1,7	K,C

* **K: Knowledge, S: Skills, C: Competency**

Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

- **Interactive videos**
- **Practice Labs**
- **Discussion Forums**
- **✓Quizzes**
- **Other Interactive online activities**
- **Reports**

Course Policies:

A- Attendance policies:

The maximum allowed absences is 15% of the lectures.

B- Absences from exams and handing in assignments on time:

Midterm exam can be retaken based on approval of excuse by the instructor's discretion.

Not handing assignment on time will incur penalties.

C- Academic Health and safety procedures

D- Honesty policy regarding cheating, plagiarism, and misbehaviour:

Cheating, plagiarism, misbehaviour will result in zero grade and further disciplinary actions may be taken.

E- Grading policy:

- All homework is to be posted online through the e-learning system.
- Exams will be marked within 72 hours and the marked exam papers will be handed to the students.
- Online Activities (Course Videos, Practice labs, Discussion Forums, Quizzes) **20%**
- Midterm **30%**
- Final Exam **50%**

F- Available university services that support achievement in the course: **E-Learning Platform, Labs, Library.**

Required equipment:

- **PC / Laptop with webcam and mic**
- **Internet Connection**
- **Access to the IU E-Learning Platform at:** https://elearn.iu.edu.jo/course/view.php?id=2107
- **E-learning plan**
- **Satisfaction questionnaires for online and face-to-face learning**
- **Software for e-learning**
- **Training**

Assessment Tools implemented in the course:

- ✓ Final Exam
- ✓ Midterm Exam
- ✓ Quizzes
- ✓ Homework
- Practice Labs
- Discussion Forums
- Periodic reports for learning assessment
- Improvement plans for online or face-to-face teaching
- Others:…….

Responsible Persons and their Signatures:

Course Coordinator	**Dr. Wissam Alkhadour**	**Completed Date**	**6/ 12 / 2022**

		Signature	

Received by (Department Head)	**Dr.**	**Received Date**	**15/ 12 / 2022**
		Signature	