The University of Jordan

الجامعة االردنية

Form: Course Syllabus	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	23/01/2023
	Number of Pages	07

1.	Course Title	**Groundwater modeling and hydrodynamics**
2.	Course Number	0305962
3.	Credit Hours (Theory, Practical)	3, theory
	Contact Hours (Theory, Practical)	3, theory
4.	Prerequisites/ Corequisites	-
5.	Program Title	Ph.D. in Geology
6.	Program Code	-
7.	School/ Center	School of Science
8.	Department	Geology
9.	Course Level	Ph D program
10.	Year of Study and Semester (s)	-
11.	Other Department(s) Involved in Teaching the Course	-
12.	Main Learning Language	English
13.	Learning Types	☒Face to face learning ☐Blended ☐Fully online
14.	Online Platforms(s)	☒Moodle ☒Microsoft Teams
15.	Issuing Date	25/04/2025
16.	Revision Date	

17. Course Coordinator:

Name: Mustafa Al Kuisi Office number: Geo307 Contact hours:
Phone number:0796906169 Email:
mkuisi@ju.edu.jo

18. Other Instructors:

Name:
Office number:
Phone number:
Email:
Contact hours:

19. Course Description:

This course provides an advanced study of groundwater flow modeling and hydrodynamic processes in aquifers. Topics include principles of saturated and unsaturated flow, development of conceptual and numerical groundwater models, application of MODFLOW and GMS software, boundary conditions, solute transport, model calibration and validation, uncertainty analysis, and integration of hydrochemical data. Students will develop skills to design, execute, and interpret groundwater models for solving complex hydrogeological problems and managing groundwater resources sustainably

20. Program Student Outcomes (SO's): (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

(SO1) Students will be able to design and execute original research, employing advanced methodologies to generate new knowledge in their specialized area of geology

(SO2) Students will display the potential to seriously evaluate complex geological problems, the usage of analytical and problem-fixing capabilities to develop modern answers and interpretations of their studies.

(SO3) Students will benefit know-how in using cutting-edge gear, techniques, and technology applicable to their geological research, applying these abilities to research and cope with complicated geological phenomena.

(SO4) Students will effectively communicate their studies findings via academic guides, presentations, and conferences, making significant contributions to the scientific network and attractive technical and non-technical audiences.

(SO5) Students will showcase a sturdy dedication to ethical studies practices and apprehend the broader societal and environmental effects of their work, promoting sustainability and integrity within the subject.

(SO6) Students will demonstrate a determination to persistent mastering, actively enticing with rising studies, and professional improvement possibilities to maintain and amplify their know-how throughout their careers.

PILO's	*National Qualifications Framework Descriptors*		
	Knowledge (A)	**Skills (B)**	**Competency (C)**
1	☐	☒	☐
2	☐	☒	☐
3	☐	☒	☐
4	☐	☒	☐
5	☐	☐	☒
6	☐	☐	☒

* Choose only one descriptor for each learning outcome of the program, whether knowledge, skill, or competency.

21. Course Intended Learning Outcomes (CLO's): (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

A- The aim of this course is to provide:

An advanced understanding of groundwater flow modeling principles, tools, and applications, with a focus on developing students' capabilities to analyze, build, and interpret integrated groundwater models for real-world hydrogeological problems.

B- Students Learning Outcomes (SLOs):

Academic Knowledge & Understanding:

- **CLO1**: Explain the fundamental concepts of groundwater flow and hydrodynamic processes.
- **CLO3**: Critically evaluate model calibration, validation, and sensitivity analysis procedures.

Practical Skills:

CLO2: Apply and analyze numerical groundwater flow models using software like MODFLOW and GMS.
CLO4: Design integrated groundwater models incorporating flow and solute transport processes.
CLO5: Assess real-world groundwater problems using hydrogeological modeling techniques.
CLO6: Conduct independent research projects applying advanced groundwater modeling methods.

Course CLOs	The learning levels to be achieved					
	Remembering	**Understanding**	**Applying**	**Analyzing**	**evaluating**	**Creating**
CLO (1)	✔	✔	✔			
CLO (2)		✔	✔	✔		
CLO (3)			✔	✔	✔	
CLO (4)			✔	✔	✔	✔
CLO (5)			✔	✔	✔	
CLO (6)				✔	✔	✔

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

PILO's * / CLO's	1	2	3	4	5	6	Descriptors**		
							A	B	C
1	☒	☒	☒	☒	☒	☒	☐	☒	☐
2	☐	☒	☐	☒	☐	☐	☐	☒	☐
3	☐	☒	☒	☐	☐	☒	☐	☒	☐
4	☐	☐	☐	☒	☐	☐	☐	☒	☐
5	☐	☐	☐	☐	☒	☐	☐	☐	☒

*Linking each course learning outcome (CLO) to only one program outcome (PLO) as specified in the course matrix.
**Descriptors are determined according to the program learning outcome (PLO) that was chosen and according to what was specified in the program learning outcomes matrix in clause (21).

23. **Topic Outline and Schedule:**

24.

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types (Face to Face/ Blended/ Fully Online)	Platform Used	Synchronous / Asynchronous Lecturing	Evaluation Methods	Learning Resources
1	1	Introduction to groundwater modeling and hydrodynamics	1, 5	Face to Face	-	Synchronous	Participation	Lecture notes
2	2	Governing equations of groundwater flow	1, 2	Face to Face	-	Synchronous	Assignment	Textbook
3	3	Conceptual model development	1, 2	Face to Face	-	Synchronous	Homework	Textbook
4	4	Numerical methods (FDM, FEM)	1, 2, 5	Face to Face	-	Synchronous	Homework	Readings
5	5	Boundary conditions in groundwater modeling	2, 5	Face to Face	-	Synchronous	Assignment	Lecture notes
6	6	Solute transport modeling fundamentals	2, 4	Face to Face	-	Synchronous	Assignment	Readings
7	7	Software training: MODFLOW, GMS	2, 3	Face to Face	-	Synchronous	Practical work	Software guide
8	8	**Midterm Exam**	-	Face to Face	-	Synchronous	Midterm	-
9	9	Chemical changes in groundwater flow	2, 5	Face to Face	-	Synchronous	Project work	Case studies
10	10	Model calibration and sensitivity analysis	3, 4, 5	Face to Face	-	Synchronous	Project	Software
11	11	Groundwater management modeling	5	Face to Face	-	Synchronous	Assignment	Articles
12	12	Coupled flow and transport modeling	5	Face to Face	-	Synchronous	Project work	Articles
13	13	Uncertainty analysis in modeling	4, 5	Face to Face	-	Synchronous	Presentation	Readings
14	14	Research applications: Case studies	2, 3, 4, 6	Face to Face	-	Synchronous	Final Project	Research papers
15	15	Final project presentations	4, 5, 6	Face to Face	-	Synchronous	Final project evaluation	-

25. Evaluation Methods:

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

Evaluation Activity	*Mark wt.	CILO's					
		1	2	3	4	5	6
First Exam	30	☒	☒		☒	☒	
Second Exam –If any							
Final Exam	40			☒	☒	☒	☒
**Class work							
Projects/reports							
Research working papers	10	☒	☒	☒	☒	☒	☒
Field visits							
Practical Exam							
Performance Completion file							
Presentation/exhibition	20	☒	☒	☒	☒	☒	☒
Any other approved works							
Total 100%	100						

* According to the instructions for granting a Bachelor's degree.

**According to the principles of organizing semester work, tests, examinations, and grades for the bachelor's degree.

Mid-term exam specifications table*

No. of questions/ cognitive level						No. of questions per CLO	Total exam mark	Total no. of questions	CILO/ Weight	CILO no.
Create **%10**	Evaluate **%10**	analyse **%10**	Apply %20	Understand **%20**	Remember %30					
1	1	1	4	2	1	10	100	100	10%	1
										2
										3
										4
										5

Final exam specifications table

No. of questions/ cognitive level						No. of questions per CLO	Total exam mark	Total no. of questions	CILO Weight	CILO no.
Create **%10**	Evaluate **%10**	analyse **%10**	Apply %20	Understand **%20**	Remember %30					
										1
										2
										3
										4
										5

26. Course Requirements:

students should have a computer, internet connection, account on a specific software/platform…(elearning)

Software:

- GMS
- Modflow

27. Course Policies:

A. Attendance policies: Students should attend at least 80% of the total number of lectures.

B. Absences from exams and submitting assignments on time: Students who miss an exam must submit and acceptable excuse and then a makeup exam will be appointed.

C. Health and safety procedures: Students should follow the university regulations.

D. Honesty policy regarding cheating, plagiarism, misbehavior: According to university regulations.

E. Grading policy:

1. Mid exam 30%
2. Homework/Seminar/Quiz 30%
3. Final exam: 40%.

The current university's letter grade scale is adopted.

F. Available university services that support achievement in the course: Central library, personal computer labs at different locations in the university, e-learning site, faculty member's website, etc.

28. References:

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

- Anderson, M.P., and Woessner, W.W. (2002). Applied Groundwater Modeling: Simulation of Flow and Advective Transport. Academic Press.
- Zheng, C., and Bennett, G.D. (2002). Applied Contaminant Transport Modeling. Wiley-Interscience.

B- Recommended books, materials, and media:

- Bear, J. (1979). *Hydraulics of Groundwater*. McGraw-Hill.
- Harbaugh, A.W. (2005). *MODFLOW-2005 documentation and user manual* (U.S. Geological Survey).

29. Additional information:

Name of the Instructor or the Course Coordinator:	Signature:	Date:
Prof. Dr. Mustafa Al Kuisi		20/01/2025
Name of the Head of Department	Signature:	Date:
Dr Bety Saqarat	Bety	20.01.2025
Name of the Head of Graduate Studies/ School of Science	Signature:	Date:
Prof. Kamal Swaidan		23/1/2025
Name of the Dean or the Director	Signature:	Date:
Prof. Mahmoud I. Jaghoub		27/1/2025