



مواصفات مقرر: علم المياه

Course Specification of: Hydrology

المعلومات العامة عن المقرر General information about the course						
1.	اسم المقرر Course Title	Hydrology				
2.	رمز المقرر ورقمه Course Code and Number	GEOS461 جيوس 461				
3.	الساعات المعتمدة للمقرر Credit Hours	الساعات المعتمدة Credit Hours			الإجمالي Total	
		محاضرات Lecture	عملي Practical	سمنار/تمارين Seminar/Tutorial		تدريب Training
		2	1	0	0	3
4.	المستوى والفصل الدراسي Study Level and Semester	Fourth/ 1 st semester				
5.	المتطلبات السابقة للمقرر (إن وجدت) Pre-requisites (if any)	GEOS335				
6.	المتطلبات المصاحبة (إن وجدت) Co-requisites (if any)					
7.	البرنامج الذي يدرس له المقرر Program(s) in which the course is offered	Geosciences, Engineering Geology				
8.	لغة تدريس المقرر Language of teaching the course	English/ Arabic				
9.	نظام الدراسة Study System	Semester/ Regular				
10.	مكان تدريس المقرر Location of teaching the course	Faculty of Petroleum and Natural Sciences Building				
11.	اسم معد (و) مواصفات المقرر Prepared by	Dr. Ahmed Saif Al-Mikhlaifi				
12.	تاريخ اعتماد مجلس الجامعة Date of Approval					

وصف المقرر Course Description	
وصف المقرر بالإنجليزية	وصف المقرر بالعربية
Water is one of our most important natural resources. Hydrology deals with the waters of the earth, their occurrence, circulation, and distribution. Hydrology is also encompasses chemical and physical properties of water and waters interactions with their environment, including their relation to living beings. Hydrological investigations, including the collection and interpretation of data on precipitation, evapotranspiration, discharge etc., are essential for the practical planning and design of water development schemes.	تعتبر المياه أحد أهم الموارد الطبيعية، وعلم المياه هو العلم الذي يختص بدراسة مياه الأرض، تواجدها، توزيعها و سريانها، يشمل أيضا دراسة خواص المياه الفيزيائية والكيميائية وتفاعل المياه مع البيئة وكذا علاقته بالحياه. التحققات الهيدرولوجية تشمل جمع وتفسير البيانات عن الأمطار، النتح-البخر، التفرغ... الخ لتستخدم كأساس عملي لوضع خطط تطويرية لتنمية الموارد المائية.

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Course Intended Learning Outcomes (CILOs) مخرجات تعلم المقرر

After completing the course, the student will be able to:		بعد الانتهاء من دراسة المقرر سوف يكون الطالب قادرا على أن:	
a1.	Define and explain fundamentals about the definition and subjects of hydrology, hydrological cycle, water balance and global water supply. Basic terms about precipitation, evaporation and evapotranspiration can also be explained.	يعرف ويشرح اساسيات علم المياه والمواضيع المتعلقة به مثل دورة المياه، التوازن المائي، الامداد المائي العالمي، ايضا المصطلحات المتعلقة بالأطمار، البحر... الخ	- a1
a2.	Can define the key components of a functioning groundwater, can determine the main aquifer properties-permeability, transmissivity and storage. Identify geological formations capable of storing and transporting groundwater.	يحدد الوظائف الرئيسية للمياه الجوفية، وتحديد الخواص الرئيسية مثل النفاذية، المسامية، والخرن. ايضا التعرف على المكونات الجيولوجية القادرة على خزن ونقل المياه الجوفية.	- a2
b1.	An ability to synthesize hydrologic data (e.g. surface water, groundwater, water quality)	يكون قادرا على تخليق بيانات تتعلق بعلم المياه.	-b1
b2.	An ability to analyze hydrologic data (e.g. surface water, groundwater, water quality)	يكون قادرا على تحليل البيانات الهيدرولوجية.	- B2
c1.	Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management	يستخدم أساسيات العلوم الهندسة لحل المشاكل الحالية، وتوقع وتقليل ومنع المشاكل المستقبلية في المنطقة الواقعة تحت اشراف وادارة الموارد المائية.	- c1
c2.	Calculate flow rate by using velocity and cross section measurements.	يحسب معدل الأنسياب باستخدام قياس سرعة الماء وكذا القطاع العرضي.	- C2
d1.	Negotiate difficult social situations, defuse conflict and engage positively in purposeful debate	يناقش الحالات الاجتماعية الحرجة، ويطفئ النزاعات ويتدخل بشكل ايجابي في الحوارات الهادفة.	- d1
d2.	Argue effectively and a willingness to engage in self-appraisal	يحاوّر بشكل فاعل وعنده الرغبة في التقييم الذاتي.	- d2

مواءمة مخرجات تعلم المقرر مع مخرجات التعلم للبرنامج:

Alignment of CILOs (Course Intended Learning Outcomes) to PILOs (Program Intended Learning Outcomes)

مخرجات التعلم المقصودة من المقرر (Course Intended Learning Outcomes)		مخرجات التعلم المقصودة من البرنامج (Program Intended Learning Outcomes) (تكتب جميع مخرجات البرنامج كما هي رمزا ونصا)	
a1	Define and explain fundamentals about the definition and subjects of hydrology, hydrological cycle, water balance and global water supply. Basic terms about precipitation, evaporation and evapotranspiration can also be explained.	A1	Demonstrate knowledge and understanding of geological-specific theories, paradigms, concepts and principles, in addition to general literature and basic science.



a2	Describe the key components of a functioning groundwater, can determine the main aquifer properties-permeability, transmissivity and storage identify geological formations capable of storing and transporting groundwater.	A2	Explain fundamental geological principles and concepts in theoretical, practical and vocational situations and the possibility of applying them.
b1	Synthesize hydrologic data (e.g. surface water, groundwater, water quality).	B1	An ability to link synthesized geological data on a range of spatial and temporal scales to allow for scientific interpretations.
b2	Analyze hydrologic data (e.g. surface water, groundwater, water quality).	B2	An ability to apply disciplinary knowledge and skills in solving geological and environmental problems logically and professionally.
C1	Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management.	C2	An ability to deal with new and established technologies with efficiency to collect and interpret geological data, recognizing their strengths and limitations.
c2	Calculate flow rate by using velocity and cross section measurements.	C5	An ability to collect various geological data, integrate, scientifically interpret, and report them.
d1	Negotiate difficult social situations, defuse conflict and engage positively in purposeful debate	D2	Demonstrate the necessary skills of practicing responsible and personal characteristics with discipline, and ability in making decision.
d2	Argue effectively and a willingness to engage in self-appraisal	D3	Demonstrate general and impartial intellectual characteristics beyond the specialization.

مواصلة مخرجات التعلم باستراتيجيات التعليم والتعلم والتقويم Alignment of CILOs to Teaching and Assessment Strategies		
أولاً: مواصلة مخرجات تعلم المقرر (المعارف والفهم) باستراتيجيات التعليم والتعلم والتقويم: First: Alignment of Knowledge and Understanding CILOs		
مخرجات المقرر/ المعرفة والفهم Knowledge and Understanding CILOs	استراتيجية التعليم والتعلم Teaching Strategies	استراتيجية التقويم Assessment Strategies
a1 - Define and explain fundamentals	Interactive lecture	Quizzes



	about the definition and subjects of hydrology, hydrological cycle, water balance and global water supply. Basic terms about precipitation, evaporation and evapotranspiration can also be explained.	Discussion Brain storming Presentation	Examination Reports
a2 -	Describe the key components of a functioning groundwater, can determine the main aquifer properties-permeability, transmissivity and storage identify geological formations capable of storing and transporting groundwater.		

ثانياً: مواعمة مخرجات تعلم المقرر (المهارات الذهنية) باستراتيجية التدريس والتقييم:

Second: Alignment of Intellectual Skills CILOs

مخرجات المقرر/ المهارات الذهنية Intellectual Skills CILOs	استراتيجية التعليم والتعلم Teaching Strategies	استراتيجية التقييم Assessment Strategies
b1 - Synthesize hydrologic data (e.g. surface water, groundwater, water quality).	Practical work Problem solving Discussion Lecture	Quizzes Examination Reports Practical work
b2 - Analyze hydrologic data (e.g. surface water, groundwater, water quality).		

ثالثاً: مواعمة مخرجات تعلم المقرر (المهارات المهنية والعملية) باستراتيجية التدريس والتقييم:

Third: Alignment of Professional and Practical Skills CILOs

مخرجات المقرر/ المهارات المهنية والعملية Professional and Practical Skills CILOs	استراتيجية التعليم والتعلم Teaching Strategies	استراتيجية التقييم Assessment Strategies
c1- Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management.	Interactive lecture Discussion Brain storming Presentation Practical work Problem solving	Quizzes Examination Reports Practical work
c2- Calculate flow rate by using velocity and cross section measurements.		

رابعاً: مواعمة مخرجات تعلم المقرر (المهارات العامة) باستراتيجية التدريس والتقييم:

Fourth: Alignment of Transferable (General) Skills CILOs

مخرجات المقرر Transferable (General) Skills CILOs	استراتيجية التعليم والتعلم Teaching Strategies	استراتيجية التقييم Assessment Strategies
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d1-	Negotiate difficult social situations, defuse conflict and engage positively in purposeful debate	Discussion Cooperative learning Presentation Problem solving	Quizzes Examination Reports
d2-	Argue effectively and a willingness to engage in self-appraisal		

Course Content محتوى المقرر

Theoretical Aspect الموضوعات الجانب النظري

الرقم Order	الموضوعات الرئيسية/الوحدات Topic List / Units	الموضوعات الفرعية Sub Topics List	عدد الأسابيع Number of Weeks	الساعات الفعالية Contact Hours	رموز مخرجات التعلم للمقرر (CILOs)
1	Water for the world	<ul style="list-style-type: none"> basic issues demand/supply trend 	1	2	a1, a2
2	The global hydrological cycle	<ul style="list-style-type: none"> the global system, fluxes, reservoirs, and residence times evaporation, condensation, precipitation regional water balances and resources hydrological effects of climate change Climate and water availability, Water balances, Precipitation 	2	4	a1,a2, b1,b2, c1, c2
3	Catchment hydrology: Land-atmosphere interactions	<ul style="list-style-type: none"> Precipitation interception evapotranspiration - water and energy balance 	1	2	a1,a2, b1,b2, c1, c2, d1
4	Weather and Hydrology	<ul style="list-style-type: none"> subsurface flow - infiltration and soil moisture - runoff -groundwater flow 	1	2	a1,a2, b1,b2, c1, c2
5	Structure and properties of water	<ul style="list-style-type: none"> phase diagram -equilibrium - dipole - amphoteric 	1	2	a1,a2, b1,b2, c1, c2
6	Principles of fluid dynamics	<ul style="list-style-type: none"> forces on fluids fluid statics/dynamics 	1	2	a1,a2, b1,b2,

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		<ul style="list-style-type: none"> laminar and turbulent flow 			c1, c2
7	Catchment hydrology: Streams, floods and droughts	<ul style="list-style-type: none"> hydrographs nature and cause of floods flood routing estimating magnitude and frequency of extreme events patterns, cycles and teleconnections 	1	2	a1,a2, b1,b2, c1, c2, d1
8	Groundwater & Well Hydraulics	Occurrence and movement of groundwater, Darcy's law, governing ground water flow equations, Factors governing ground water flow,	1	2	a1,a2, b1,b2, c1, c2, d1
9	Groundwater & Well Hydraulics	Types of aquifers, porosity, specific yield, specific retention, storage coefficient, permeability, hydraulic conductivity, hydraulic transmissibility, Conjunctive use and it's necessity.	1	2	a1,a2, b1,b2, c1, c2
10	Reservoir	Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation and control.	1	2	a1,a2, b1,b2, c1, c2, d1
11	Precipitation and runoff	Cloud, formation of precipitation, rise of the air mass, temporal and spatial distribution of precipitation, method of measuring the precipitation amount and effective precipitation depth in a watershed.	1	2	a1,a2, b1,b2, c1, c2, d1
12	Stream flow	Runoff, infiltration, effluent and influence streams, runoff, baseflow separation , stream flow velocity profile hydrograph and routing (rating) curves, stream ordering and bifurcation ratio	1	2	a1,a2, b1,b2, c1, c2, d1
13	Flood analysis	Flood frequency duration, recurrence interval, flood attenuation and translation, hydraulic jump, Reynolds number and its relationship to turbulent and laminar, steady and uniform flow.	1	2	a1,a2, b1,b2, c1, c2,
عدد الأسابيع والساعات الفعلية Number of Weeks /and Contact Hours Per Semester			14	28	



الموضوعات العملية (إن وجدت) Practical Aspect (if any)				
الرقم Order	التجارب العملية/ التمارين / تدريبات Practical / Exercises/ Tutorials topics	عدد الأسابيع Number of Weeks	الساعات الفعالية Contact Hours	رموز مخرجات التعلم Course ILOs
1	Hydraulic Cycle Define the following terms: <ul style="list-style-type: none"> ○ Hydrology ○ Hydrologic cycle ○ Hydrogeology ○ Groundwater ○ Draw a sketch for the hydrologic cycle in the nature. ○ The elements of the hydrologic cycle 	1	2	a1,a2, b1,b2, c1, c2, d1
2	Meteorological Parameters Define the following types of climatological parameters: <ul style="list-style-type: none"> ○ Daily Temperature ○ Relative Humidity ○ Wind Speed 	1	2	a1,a2, b1,b2, c1, c2, d1
3	Precipitation (1) (Normal Ratio Method) - To learn how to estimate the missing data and record adjustment in general and explain one of them (Normal ratio method). - to calculate the missing data of rain gauge station.	1	2	a1,a2, b1,b2, c1, c2, d1
4	Precipitation (2) (Double Mass Method) - To learn how to estimate the missing data methods and record adjustment in general and explain one of them (Double mass method) - to re-correct rain gauge station data readings.	1	2	a1,a2, b1,b2, c1, c2, d1
5	Precipitation (3) (Mean Areal Depth of Precipitation) To learn the methods of how to estimate the mean areal depth of catchment area. <ul style="list-style-type: none"> ○ Thiessen Polygonal method net ○ Isohytal map 	1	2	a1,a2, b1,b2, c1, c2, d1
6	Precipitation (4) (Average rainfall Depth of the Storm) - To learn how to calculate the average rainfall depth of the storm.	1	2	a1,a2, b1,b2, c1, c2, d1
7	Estimate the Evaporation of Lakes To understand the types of evaporation pans and explain how they uses to calculate the mean	1	2	a1,a2, b1,b2, c1, c2, d1



	evaporation amounts of any surface water lakes			
8	Estimation the Evapotranspiration For the Growing Season -Student learn how to estimate the evapotranspiration of plants. - Convert between metric and FPS units.	1	2	a1,a2, b1,b2, c1, c2, d1
9	Runoff (1) The Characteristics of the Drainage Basin The characteristics of the drainage basin and calculate the following terms:- ○ The number of streams ○ The length of the streams ○ The drainage density ○ The streams density	1	2	a1,a2, b1,b2, c1, c2, d1
10	Runoff (2) Determine The Mean Slope of The Drainage Basin Use "Horton's Method" to calculate the mean slope of the drainage basins.	1	2	a1,a2, b1,b2, c1, c2, d1
11	Water Budget To learn the one of methods that used to calculate the water budget of any water system area such as Lakes, Rivers, and Aquifers ...etc.	1	2	a1,a2, b1,b2, c1, c2, d1
اجمالي الأسابيع والساعات الفعلية Number of Weeks /and Contact Hours Per Semester		11	22	

استراتيجيات التعليم والتعلم Teaching Strategies

- Interactive lecture
- Discussion
- Brain storming

الأنشطة والتكليفات Tasks and Assignments

م No	التكليف/ الواجب Assignments/ Tasks	نوع التكليف (فردى /تعاونى)	الدرجة المستحقة Mark	أسبوع التتفيذ Week Due	خرجات التعلم CILOs (symbols)
1	Conduct library research	Individual	5	W4	all
2	Class activity & Problem solving	Individual	5	throughout	all
Total Score إجمالي الدرجة			10		

تقييم التعلم Learning Assessment

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الرقم No.	أنشطة التقييم Assessment Tasks	أسوع التقييم Week due	الدرجة Mark	نسبة الدرجة إلى الدرجة النهائية Proportion of Final Assessment	مخرجات التعلم CLOs (symbols)
1	الأنشطة والتكليفات Tasks and Assignments	W2-W14	10	6.66	a1,a2, b1,b2, c1, c2, d1
2	كوز (1) Quiz (1)	W6	2.5	1.66	a1,a2, b1,b2, c1,
3	اختبار نصف الفصل Midterm Exam (Theoretical)	W8	15	10	a1,a2, b1,b2, c1, c2, d1
4	Midterm Exam (Practical)	W5	(15)	10	a1,a2, b1,b2, c1, c2, d1
5	Attendance and Participation (Practical)	All	(5)	3.33	a1,a2, b1,b2, c1, c2, d1
6	كوز (2) Quiz (2)	W12	2.5	1.66	a1,a2, b1,b2, c1,
7	اختبار نهاية الفصل (عملي) Final Exam (practical)	W 15	(30)	20	a1,a2, b1,b2, c1, c2, d1
8	اختبار نهاية الفصل (نظري) Final Exam (theoretical)	W16	70	46.66	a1,a2, b1,b2, c1, c2, d1
Total الإجمالي			150	%100	

Learning Resources مصادر التعلم

توثق المراجع حسب نظام APA (اسم المؤلف، سنة النشر، اسم الكتاب، دار النشر، بلد النشر).

Required Textbook(s) المراجع الرئيسية (لا تزيد عن مرجعين)

- Hornberger, G.M., Raffensberger, J.P., Wiberg, P.L., and Eshleman, K.N. (1998) Elements of physical hydrology. Johns Hopkins University Press, Baltimore, 302p.
- Fetter, C.W (2001) Applied Hydrogeology, Fourth Edition, Prentice –Hall, Inc. 531p.

Essential References المراجع المساندة

Holden, Joseph (Editor), *An Introduction to Physical Geography and the Environment*, Pearson Education, Paperback, Nov 2004. ISBN13: 9780131217614; ISBN10: 0131217615.

Electronic Materials and Web Sites etc. المصادر الإلكترونية ومواقع الإنترنت

Course Policies الضوابط والسياسات المتبعة في المقرر

1	Class Attendance حضور الفعاليات التعليمية	- Attendance is compulsory at all scheduled lectures and practical sessions. A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure and will be required to retake the course again.
2	Tardy الحضور المتأخر	- For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	Exam Attendance/Punctuality ضوابط الامتحان	- The student should attend the exam on time. He/she is allowed to attend the exam within half an hour from the beginning of the exam, after that if late he/she will not be permitted to take the exam

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	and will be considered as absent.
4	<p>Assignments & Projects التعيينات والمشاريع</p> <ul style="list-style-type: none"> - Student has to submit all the assignments/reports for checking on time, mostly one week after given the assignment.
5	<p>Cheating الغش</p> <ul style="list-style-type: none"> - Any student caught cheating will be expelled from the exam hall, and referred to a disciplinary council to apply the penalties as stipulated in the Student Affairs Regulations (SAR). Usually student will be assigned a course grade of F (Fail), more actions will be applied subject to the case in agreement with the SAR.
6	<p>Plagiarism الانتحال</p> <ul style="list-style-type: none"> - Plagiarism means if you copy the work of another person and turn it in as your own, so plagiarism is one of the worst academic sins. - Academic integrity, with its embodied values, is seen as a foundation of Sana'a University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to provide students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. Such behavior will lead to severe punishment liable to faculty/department evaluation.
7	<p>Other policies سياسات أخرى</p> <ul style="list-style-type: none"> - During class lectures, please make sure that all cell phones must be off or on silent and put away in your pocket, or backpack or purse. They should not be visible during class. Audio and/or visual recording devices including, but not limited to, computers, personal digital assistants (PDA's), iPods, tape recorders, and cameras are not permitted to be on-they should be turned off and put away in your pocket, backpack or purse. Failure to comply with these policies will result in exclusion from the class. - Students are not allowed to carry a cell phone or any relevant material into the exam hall, otherwise any such act will be treated as a cheating case, and disciplinary action will be taken according to University rules as above.



قسم/ برنامج: العلوم الجيولوجية
العام الجامعي: 2019-2020م

خطة مقرر: علم المياه Course Plan (Syllabus): Hydrology

معلومات عن أستاذ المقرر Information about Faculty Member Responsible for the Course						
الاسم Name	Ahmed Saif Al-Mikhlaifi		الساعات المكتبية (أسبوعياً) Office Hours			
المكان ورقم الهاتف Location & Telephone No.	Sana'a, +967 777554655		السبت SAT	الأحد SUN	الاثنين MON	الثلاثاء TUE
البريد الإلكتروني E-mail	ahmedmikhlaifi@hotmail.com					الأربعاء WED
						الخميس THU

معلومات عامة عن المقرر General information about the course					
1.	اسم المقرر Course Title	Hydrology			
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4.	المستوى والفصل الدراسي Study Level and Semester	Final Year/ First semester			
5.	المتطلبات السابقة للمقرر Pre-requisites				
6.	المتطلبات المصاحبة (إن وجدت) Co-requisite	Geosciences, Engineering Geology			
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9.	مكان تدريس المقرر Location of teaching the course	Faculty of Petroleum and Natural Sciences Building			

وصف المقرر Course Description	
Water is one of our most important natural resources. Hydrology deals with the waters of the earth, their occurrence, circulation, and distribution. Hydrology is also encompasses chemical and physical properties of water and waters interactions with their environment, including their relation to living beings. Hydrological investigations, including the collection and	تعتبر المياه أحد أهم الموارد الطبيعية، وعلم المياه هو العلم الذي يختص بدراسة مياه الأرض، تواجدها، توزيعها و سريانها، يشمل أيضا دراسة خواص المياه الفيزيائية والكيميائية وتفاعل المياه مع البيئة وكذا علاقته بالحياه. التحقيقات الهيدرولوجية تشمل جمع وتفسير البيانات عن الأمطار، النتح-البخر،

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interpretation of data on precipitation, evapotranspiration, discharge etc., are essential for the practical planning and design of water development schemes.	التفريغ... الخ لتستخدم كأساس عملي لوضع خطط تطويرية لتنمية الموارد المائية.
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Course Intended Learning Outcomes (CILOs) مخرجات تعلم المقرر	
After completing the course, the student will be able to:	بعد الانتهاء من دراسة المقرر سوف يكون الطالب قادرا على أن:
a1. Define and explain fundamentals about the definition and subjects of hydrology, hydrological cycle, water balance and global water supply. Basic terms about precipitation, evaporation and evapotranspiration can also be explained.	a1. يعرف ويشرح أساسيات علم المياه والمواضيع المتعلقة به مثل دورة المياه، التوازن المائي، الامداد المائي العالمي، ايضا المصطلحات المتعلقة بالأمطار، البحر... الخ
a2. Can define the key components of a functioning groundwater, can determine the main aquifer properties-permeability, transmissivity and storage Identify geological formations capable of storing and transporting groundwater.	a2. يُحدد الوظائف الرئيسية للمياه الجوفية، وتحديد الخواص الرئيسية مثل النفاذية، المسامية، والخرن. ايضا التعرف على المكونات الجيولوجية القادرة على خزن ونقل المياه الجوفية.
b1. Synthesize hydrologic data (e.g. surface water, groundwater, water quality)	b1. يكون قادرا على تخليق بيانات تتعلق بعلم المياه.
b2. Analyze hydrologic data (e.g. surface water, groundwater, water quality)	b2. يكون قادرا على تحليل البيانات الهيدرولوجية.
c1. Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management	c1. يستخدم أساسيات العلوم الهندسة لحل المشاكل الحالية، وتوقع وتقليل ومنع المشاكل المستقبلية في المنطقة الواقعة تحت اشراف وإدارة الموارد المائية.
c2. Calculate flow rate by using velocity and cross section measurements.	c2. يحسب معدل الانسياب باستخدام قياس سرعة الماء وكذا القطاع العرضي.
d1. Negotiate difficult social situations, defuse conflict and engage positively in purposeful debate	d1. يناقش الحالات الاجتماعية الحرجة، ويطفيء النزاعات ويتدخل بشكل ايجابي في الحوارات الهادفة.
d2. Argue effectively and a willingness to engage in self-appraisal	d2. يحاور بشكل فاعل وعنده الرغبة في التقييم الذاتي.

Course Content محتوى المقرر				
Theoretical Aspect خطة تنفيذ الموضوعات النظرية				
الرقم Order	الوحدات (الموضوعات الرئيسية) Units	الموضوعات التفصيلية Sub Topics	الأسبوع Week Due	الساعات الفعالية Con. H

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1	Water for the world	<ul style="list-style-type: none"> • basic issues • demand/supply • trends 	W1	2
2	The global hydrological cycle	<ul style="list-style-type: none"> • the global system, fluxes, reservoirs, and residence times • evaporation, condensation, precipitation • regional water balances and resources • hydrological effects of climate change 	W2	2
3	=	<ul style="list-style-type: none"> • Climate and water availability, Water balances, Precipitation 	W3	2
4	Catchment hydrology: Land-atmosphere interactions	<ul style="list-style-type: none"> • precipitation • interception • evapotranspiration <ul style="list-style-type: none"> ○ water and energy balance 	W4	2
5	Weather and Hydrology	<ul style="list-style-type: none"> • subsurface flow <ul style="list-style-type: none"> ○ infiltration and soil moisture ○ runoff ○ groundwater flow 	W5	2
6	Structure and properties of water	<ul style="list-style-type: none"> • phase diagram • equilibrium • dipole • amphoteric 	W6	2
7	Principles of fluid dynamics	<ul style="list-style-type: none"> • forces on fluids • fluid statics/dynamics • laminar and turbulent flow 	W7	2
8	Mid-Term Exam	All previous lectures	W1- W7	2
9	Catchment hydrology: Streams, floods and droughts	<ul style="list-style-type: none"> • hydrographs • nature and cause of floods • flood routing • estimating magnitude and frequency of extreme events • patterns, cycles and teleconnections 	W8	2
10	Groundwater & Well Hydraulics	Occurrence and movement of groundwater, Darcy's law, governing ground water flow equations, Factors governing ground water flow,	W9	2
11	Groundwater &	Types of aquifers, porosity, specific yield, specific	W10	2



	Well Hydraulics	retention, storage coefficient, permeability, hydraulic conductivity, hydraulic transmissibility, Conjunctive use and it's necessity.		
12	Reservoir	Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation and control.	W11	2
13	Precipitation and runoff	Cloud, formation of precipitation, rise of the air mass, temporal and spatial distribution of precipitation, method of measuring the precipitation amount and effective precipitation depth in a watershed.	W12	2
14	Stream flow	Runoff, infiltration, effluent and influence streams, runoff, baseflow separation , stream flow velocity profile hydrograph and routing (rating) curves, stream ordering and bifurcation ratio	W13	2
15	Flood analysis	Flood frequency duration, recurrence interval, flood attenuation and translation, hydraulic jump, Reynolds number and its relationship to turbulent and laminar, steady and uniform flow.	W14	2
16	Final Exam	All previous lectures	W1- W14	2
عدد الأسابيع والساعات الفعلية Number of Weeks /and Contact Hours Per Semester			14	32

Practical / Training/ Tutorials/ Exercises Aspects خطة تنفيذ موضوعات الجانب العملي			
الرقم Order	موضوعات العملي/ المهام / التمارين Practical/ Tutorials/ Exercises Aspects	الأسبوع Week Due	الساعات الفعلية Cont. H
1	Hydraulic Cycle Define the following terms: <ul style="list-style-type: none"> ○ Hydrology ○ Hydrologic cycle ○ Hydrogeology ○ Groundwater ○ Draw a sketch for the hydrologic cycle in the nature. ○ The elements of the hydrologic cycle 	W1	2
2	Meteorological Parameters Define the following types of climatological parameters: <ul style="list-style-type: none"> ○ Daily Temperature ○ Relative Humidity ○ Wind Speed 	W2	2
3	Precipitation (1) (Normal Ratio Method) - To learn how to estimate the missing data and record adjustment in general and explain one of them (Normal ratio method).	W3	2

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	- to calculate the missing data of rain gauge station.		
4	Precipitation (2) (Double Mass Method) - To learn how to estimate the missing data methods and record adjustment in general and explain one of them (Double mass method) - to re-correct rain gauge station data readings.	W4	2
5	Precipitation (3) (Mean Areal Depth of Precipitation) To learn the methods of how to estimate the mean areal depth of catchment area. ○ Thiessen Polygonal method net ○ Isoheytal map	W5	2
6	Precipitation (4) (Average rainfall Depth of the Storm) - To learn how to calculate the average rainfall depth of the storm.	W6	2
7	Mid-Term Exam	W1-W6	2
7	Estimate the Evaporation of Lakes To understand the types of evaporation pans and explain how they uses to calculate the mean evaporation amounts of any surface water lakes	W7	2
8	Estimation the Evapotranspiration For the Growing Season -Student learn how to estimate the evapotranspiration of plants. - Convert between metric and FPS units.	W8	2
9	Runoff (1) The Characteristics of the Drainage Basin The characteristics of the drainage basin and calculate the following terms:- ○ The number of streams ○ The length of the streams ○ The drainage density ○ The streams density	W9	2
10	Runoff (2) Determine The Mean Slope of The Drainage Basin Use "Horton's Method" to calculate the mean slope of the drainage basins.	W10	2
11	Water Budget To learn the one of methods that used to calculate the water budget of any water system area such as Lakes, Rivers, and Aquifers ...etc.	W11	2
13	Final Exam	W1-W11	2
اجمالي الأسابيع والساعات الفعلية Number of Weeks /and Contact Hours Per Semester		13	26

استراتيجيات التعليم والتعلم Teaching Strategies

- Interactive lecture
- Discussion
- Brain storming

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Tasks and Assignments الأنشطة والتكليفات

م No	التكليف/ الواجب Assignments	نوع التكليف (فردى/ تعاونى)	الدرجة المستحقة Mark	أسبوع التنفيذ Week Due
1	Conduct library research	Individual	5	W4
2	Class activity & Problem solving	Individual	5	throughout
Total Score إجمالي الدرجة			10/150	

Learning Assessment تقويم التعلم

م No	أساليب التقويم Assessment Method	موعد (أسبوع) التقويم Week Due	الدرجة Mark	الوزن النسبي % Proportion of Final Assessment
1	الأنشطة والتكليفات Tasks and Assignments	W2-W14	10	6.66
2	كوز (1) Quiz	W6	2.5	1.66
3	اختبار نصف الفصل Midterm Exam (Theoretical)	W8	15	10
4	Midterm Exam (Practical)	W5	(15)	10
5	Lab activity and Participation (Practical)	All	(5)	3.33
6	كوز (2) Quiz	W12	2.5	1.66
7	اختبار نهاية الفصل (عملي) Final Exam (practical)	W 15	(30)	20
8	اختبار نهاية الفصل (نظري) Final Exam (theoretical)	W16	70	46.66
Total المجموع			150	100 %

Learning Resources مصادر التعلم

توثق المراجع حسب نظام APA (اسم المؤلف، سنة النشر، اسم الكتاب، دار النشر، بلد النشر).

Required Textbook(s) المراجع الرئيسية (لا تزيد عن مرجعين)

- Hornberger, G.M., Raffensberger, J.P., Wiberg, P.L., and Eshleman, K.N. (1998) Elements of physical hydrology. Johns Hopkins University Press, Baltimore, 302p.
- Fetter, C.W (2001) Applied Hydrogeology, Fourth Edition, Prentice –Hall, Inc. 531p.

Essential References المراجع المساندة

Holden, Joseph (Editor), *An Introduction to Physical Geography and the Environment*, Pearson Education, Paperback, Nov 2004. ISBN13: 9780131217614; ISBN10: 0131217615.

Electronic Materials and Web Sites etc. المصادر الإلكترونية ومواقع الإنترنت

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Course Policies الضوابط والسياسات المتبعة في المقرر

1	Class Attendance حضور الفعاليات التعليمية - Attendance is compulsory at all scheduled lectures and practical sessions. A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure and will be required to retake the course again.
2	Tardy الحضور المتأخر - For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	Exam Attendance/Punctuality ضوابط الامتحان - The student should attend the exam on time. He/she is allowed to attend the exam within half an hour from the beginning of the exam, after that if late he/she will not be permitted to take the exam and will be considered as absent.
4	Assignments & Projects التعيينات والمشاريع - Student has to submit all the assignments/reports for checking on time, mostly one week after given the assignment.
5	Cheating الغش - Any student caught cheating will be expelled from the exam hall, and referred to a disciplinary council to apply the penalties as stipulated in the Student Affairs Regulations (SAR). Usually student will be assigned a course grade of F (Fail), more actions will be applied subject to the case in agreement with the SAR.
6	Plagiarism الانتحال - Plagiarism means if you copy the work of another person and turn it in as your own, so plagiarism is one of the worst academic sins. - Academic integrity, with its embodied values, is seen as a foundation of Sana'a University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to provide students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. Such behavior will lead to severe punishment liable to faculty/department evaluation.
7	Other policies سياسات أخرى - During class lectures, please make sure that all cell phones must be off or on silent and put away in your pocket, or backpack or purse. They should not be visible during class. Audio and/or visual recording devices including, but not limited to, computers, personal digital assistants (PDA's), iPods, tape recorders, and cameras are not permitted to be on-they should be turned off and put away in your pocket, backpack or purse. Failure to comply with these policies will result in exclusion from the class. - Students are not allowed to carry a cell phone or any relevant material into the exam hall, otherwise any such act will be treated as a cheating case, and disciplinary action will be taken according to University rules as above.