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| EXC-01-02-02A | **Form Number** | **Form:**  **Course Syllabus** |
| 2/3/24/2022/2963  05/12/2022 | **Issue Number and Date** |
|  | **Number and Date of Revision or Modification** |
| 2/3/24/2023 | **Deans Council Approval Decision Number** |
| 23/01/2023 | **The Date of the Deans Council Approval Decision** |
| 06 | **Number of Pages** |

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| **1.** | **Course Title** | **Water Resources and Management** |
| **2.** | **Course Number** | 634410 |
| **3.** | **Credit Hours (Theory, Practical)** | 3 |
| **Contact Hours (Theory, Practical)** | 3 |
| **4.** | **Prerequisites/ Corequisites** | Hydrology 0604212 |
| **5.** | **Program Title** | Land, Water, and Environment |
| **6.** | **Program Code** | 141 |
| **7.** | **School/ Center** | University of Jordan |
| **8.** | **Department** | Agriculture |
| **9.** | **Course Level** | Land, Water, and Environment |
| **10.** | **Year of Study and Semester (s)** | Fourth-year |
| **11.** | **Other Department(s) Involved in Teaching the Course** | 2022/2023 second semester |
| **12.** | **Main Learning Language** | None |
| **13.** | **Learning Types** | English |
| **14.** | **Online Platforms(s)** | ☐Face to face learning ☒Blended ☐Fully online |
| **15.** | **Issuing Date** | ☒Moodle ☒Microsoft Teams ☐Skype ☐Zoom  ☐Others………… |
| **16.** | **Revision Date** | 25/9/2024 |

**17 Course Coordinator:**

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| Name: Dr. Michel Rahbeh Contact hours: Wednesday, Monday 11:00-12:30  Office number: 054 Phone number: 0775197474 or ext 22442  Email: m.rahbeh@ju.edu.jo |

**18 Other instructors: N/A**

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

**19 Course Description:**

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| **Topics**: Students will be introduced to the concepts and tools of sustainable water management that can be applied to the quantitative and qualitative management of water resources. The material consists of six parts. The first part introduces surface and groundwater as connected resources and related sustainability concepts for water resources. Part II reviews the quantification of the hydrological cycle in the context of hydrological modeling of watersheds. This segment covers the direction of runoff flow through channels and reservoirs. The third part focuses on the physical properties of groundwater and the quantification of these properties using pumping tests. This section also includes a discussion of the harmful effects of pumping on confined and unconfined groundwater. Part IV is devoted to water quality standards and related hazards, Part V discusses the random analysis of hydrological events such as the determination of return periods, analysis of the frequency of severe floods, and calculation of drought indicators. The sixth and final part discusses dam management.  **Importance:** Students will acquire the knowledge needed to conduct hydrological calculations, model runoff and deal with the challenges of sustainable water management.  **Involvement of Experts**: No experts will be involved  **Active learning mechanism:** This course does not use the active learning mechanisms |

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| **20. Program Intended Learning Outcomes:** (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)   1. Demonstrate comprehensive understanding of the scientific and theoretical knowledge of land, water and environment. 2. Contribute to agricultural development, as well as food and water security. 3. Demonstrate problem solving skills and well developed linguistic and communication skills while upholding professional ethics 4. Access land characteristics and their suitability for different agricultural uses. 5. Tackle basic problems of water, land and agricultural environment. 6. Analyse and interpret soil and water quality parameters. 7. Use sound scientific principles for the determination of crop water requirement, and design of irrigation systems for the proper management of agricultural water. 8. Determine the optimal use of water and land resources to ensure the sustainability of resources and the environment. 9. Develop​ innovative solution for tackling the adverse effects of water scarcity caused by climate change and desertification​ |

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

1. Be familiar with the terminology commonly used in the water resources literature
2. Discuss the relationship between water quality and quantity and describe water quality guidelines
3. Employ necessary methods (SCS-CN, synthetic unit hydrograph, unit hydrograph base flow separation, routing) to determine runoff
4. Estimate the groundwater physical parameters from pumping tests
5. Determine drought indices
6. Calculate a return period for a given event and Conduct frequency analysis of extreme floods

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| Course ILOs | The learning levels to be achieved | | | | | |
| Remembering | Understanding | Applying | Analysing | evaluating | Creating |
| 1 | **x** |  |  |  |  |  |
| 2 |  | **x** |  |  |  |  |
| 3 |  |  |  | **x** |  | **x** |
| 4 |  |  |  |  | **x** |  |
| 5 |  |  |  |  | x |  |
| 6 |  |  |  |  | x |  |

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SLOs  SLOs of the course | ILO (1) | ILO (2) | ILO (3) | ILO (4) | ILO (5) | ILO (6) | ILO (7) | ILO (8) | ILO (9) |
| 1 | X |  |  |  |  |  |  |  |  |
| 2 | X |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  | X |  |  |  | X |
| 4 |  |  |  |  | X |  |  |  | X |
| 5 |  |  |  |  | X |  |  |  | X |
| 6 |  |  |  |  | X |  |  |  | X |

**23. Topic Outline and Schedule:**

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| | **Week** | **Lecture** | **Topic** | **Student Learning Outcome** | **Learning Methods (Face to Face/Blended/ Fully Online)** | **Platform** | **Synchronous / Asynchronous Lecturing** | **Evaluation Methods** | **Resources** | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 1 | 1.1 | Sustainability concepts of water resources global and | 1,2 | Face to Face | Classroom | **Synchronous** |  | 3 | | 1.2 | Surface and groundwater as one resource | 1,2 | Face to Face | Classroom | **Synchronous** | Interactive questions | 4 | | 1.3 | review of basic hydrological concepts | 3 | Blended (interactive videos) | Moodle | **Asynchronous** | Interactive questions | 4 | | 2 | 2.1 | Water resources in Jordan and worldwide examples | 1,2 | Face to Face | Classroom | **Synchronous** |  | 3 | | 2.2 | Muskingum routing | 3 | Face to Face | Classroom | **Synchronous** |  | 1 | | 2.3 | Review of quantification of the hydrological cycle | 3 | Blended (interactive video) | Moodle | **Asynchronous** |  | 1 | | 3 | 3.1 | Graphical determination of Muskingum parameters | 3 | Face to Face | Classroom | **Synchronous** |  | 1 | | 3.2 | Hydraulic determination of Muskingum parameters | 3 | Blended (Interactive videos) | Moodle | **Asynchronous** | Interactive quesitons | 2 | | 3.3 | Level pool routing | 3 | Face to Face | Classroom | **Synchronous** | Interactive questions | 1 | | 4 | 4.1 | Level pool routing/example | 3 | Blended (Interactive video) | Moodle | **Asynchronous** |  | 1 | | 4.2 | Confined and unconfined aquifer and hydraulic head | 4 | Face to Face | Classroom | **Synchronous** | Interactive questions | 1 | | 4.3 | hydraulic head | 4 | Face to Face | Classroom | **Synchronous** | Interactive questions | 4 | |  |  | Aquifer material | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 5.2 | Hydrological modeling example/Problem set | 3 | Blended (Interactive video) | Moodle | **Asynchronous** |  |  |  | 10 | | 5.3 | Hydrological modeling/HEC-HMS | 3 | Blended (Interactive video) | Moodle | **Asynchronous** |  |  | | 6 | 6.1 | Recharge | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 6.2 | Artesian aquifer | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 6.3 | Porosity | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 7 | 7.1 | Specific  retention | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 7.2 | Storage coefficient | 4 | Blended (video) | Moodle | **Asynchronous** | Interactive questions | 4 | | 7.3 | Flow in a a confined aquifer | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 8 | 8.1 | midterm | 22/4/2024 |  |  |  |  |  | | 8.2 | Determination of steady-state drawdown and radius of influence in a confined aquifer | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 8.3 | Land subsidence | 4 | Blended (video) | Moodle | **Asynchronous** |  | 4 | | 9 | 9.1 | Dupuit assumption and flow in an unconfined aquifer | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 9.2 | Determination of steady-state drawdown and radius of influence in a confined aquifer | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 9.3 | Subsidence | 4 | Blended (video) | Moodle | **Asynchronous** | Interactive questions | 4 | | 9.4 | Seawater intrusion | 4 | Blended (video) | Moodle | **Asynchronous** | Interactive questions | 4 | | 10 | 10.1 | Groundwater salinization | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 10.2 | Safe yield | 4 | Face to Face | Classroom | **Synchronous** |  | 4 | | 10.3 | Water quality parameter and eutrophication | 2 | Blended (video) | Moodle | **Asynchronous** | Interactive questions | 4 | | 11 | 11.1 | Hydrologic statistics | 5,6 | Face to Face | Classroom | **Synchronous** |  | 1 | | 11.2 | Probability distribution functions | 5,6 | Face to Face | Classroom | **Synchronous** |  | 1 | | 11.3 | Data fitting to probability density function | 5,6 | Face to Face | Classroom | **Synchronous** |  | 1 | | 12 | 12.1 | Return period | 5,6 | Face to Face | Classroom | **Synchronous** |  | 1 | | 12.2 | Frequency analysis | 5,6 | Face to Face | Classroom | **Synchronous** |  | 1 | | 12.3 | Plotting position formula | 5,6 | Blended (video) | Moodle | **Asynchronous** |  | 1 | | 13 | 13.1 | Extreme events | 5,6 |  | Classroom | **Synchronous** |  | 1 | | 13.2 | Drought | 5,6 |  | Classroom | **Synchronous** |  | 1 | | 13.3 | Intensity duration frequency curves | 5,6 | Blended (video) | Moodle | **Asynchronous** |  | 1 | |  | 14.1 | Linear decision rule (LDR) for reservoir management | 5,6 |  | Classroom | **Synchronous** |  | 8 | | 14.2 | Linear decision rule (LDR) for reservoir management | 5,6 |  | Classroom | **Synchronous** |  | 8 | | 14.3 | Linear decision rule (LDR) for reservoir management | 5,6 | Blended (video) | Moodle | **Asynchronous** |  | 8 | | 15 | 15.1 | review | 1-6 |  | 14 | **Synchronous** |  |  | | 15.2 | review | 1-6 |  | Classroom | **Synchronous** |  |  | | 15.3 | review | 1-6 | Blended (video) | Moodle | **Asynchronous** |  |  | |

**24 Evaluation Methods:**

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| Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements: (30% for classwork, 30% for midterm exam, 40% for final exam)   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Evaluation Activity** | **Mark** | **Topic(s)** | **SLOs** | **Period (Week)** | **Platform** | | Interactive videos | 10 | All Asynchronous | 1 to 6 | As stated in the outline and schedule | Moodle | | Quizzes | 20 | Muskingum Routing,level pool routing , flow in confined and unconfined aquifers, water quality, stochastic hydrolgy | 1 to 6 | After each topic as stated in the outline and schedule | Face to face | | Midterm | 30 | Topics up to the end of the sixth week | 1 to 6 | 22/4/2024 | Face to face | | Final exam | 40 | All topics | 1 to 6 | Exam week | Face to face | |

**25 Course Requirements**

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| students should have access to the internet and desktop computer either at home or on campus. Each student should also have a personal calculator. |

**26 Course Policies:**

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| A- Attendance policies: Regular and timely attendance is expected from all students. University regulations concerning class attendance will apply  B- Absences from exams and submitting assignments on time: The students are expected to submit home works in due time, a late submission will result in a 20% deduction of the homework grade and will not be accepted once the key answers are provided. Exams absentees are allowed to write makeup exams only if an acceptable and documented excuse is provided; for example, a medical report. Makeup exams are usually more difficult than regular exams  C- Health and safety procedures: Follow directions and notifications in case of emergency  D- Honesty policy regarding cheating, plagiarism, and misbehavior: Zero tolerance for cheating, plagiarism, and misbehavior. Use of cell phone is prohibited  E- Grading policy: the following is a suggested grading scale:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | From (%) | To (%) | Scale | Letter Grade | Result | | 86 | 100 | 4 | A | Excellent | | 83 | 85 | 3.75 | A- | Excellent | | 80 | 82 | 3.5 | B+ | Very Good | | 74 | 79 | 3.0 | B | Very Good | | 71 | 73 | 2.75 | B- | Very Good | | 68 | 70 | 2.5 | C+ | Good | | 62 | 67 | 2.0 | C | Good | | 59 | 61 | 1.75 | C- | Good | | 56 | 58 | 1.25 | D+ | Accepted | | 50 | 55 | 1.00 | D | Accepted | | 47 | 49 | 0.75 | D- | Fail | | 0 | 46 | 0 | F | Fail |   F- Available university services that support achievement in the course: For more details on University regulations please visit: http://www.ju.edu.jo/rules/index.htm |

**27 References:**

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| A- Required book(s), assigned reading and audio-visuals:   1. Chow, V. T., Maidment, D. R. and Mays, L. W. 1988. *Applied hydrology*. McGraw-Hill. 2. Song, X., Kong, F., and Zhu, Z. 2011. Application of Muskingum routing method with variable parameters in ungauged basin. *Water Science and Engineering 4(1): 1-12.* 3. EL. Nasar, H. K. 2012. Jordan’s Precious Groundwater Resources.5th ACWUA best practice conference, Muscat, Oman. 4. U.S. Army Corps of Engineers. 1999. *Engineering and design : groundwater hydrology*. Washington D.C.   B- Recommended books, materials, and media:   1. Bear, J. 1979*. Hydraulics of ground water*. New York: McGraw Hill. 2. Freeze, R. A. and Cherry J A. 1979. *Groundwater*. Prentice –Hall, Inc. 3. Nortcliff, S., Carr, G., Potter, R. and Darmame, K. 2008. Jordan’s Water Resources: Challenges for the future. Geographical paper No. 185, Reading, UK. 4. Revelle, C., Joeres, E. and Kirby, W. 1969. The linear decision rule in reservoir management and design . 1. Development of stochastic model, *Water Resources Research* 5(4): 767 – 777. 5. USGS. Eutrophication Last retrieved April 13, 2014 from <http://toxics.usgs.gov/definitions/eutrophication.html> 6. http://www.hec.usace.army.mil/software/hec-hms/ |

**28 Additional information:**

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| **Tips for Success**   * Results from previous semesters showed that successful students are those who attended the classes regularly. * Solve all your homework yourself, it’s worth the effort. Consider the following popular saying**: "**I hear and I forget. I see and I remember. ***I do and I understand***." |

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| Name of the Instructor or the Course Coordinator:  ………………………………………………… | Signature:  …………...……………… | Date:  ……..………… |
| Name of the Head of Quality Assurance Committee/ Department  …………………………………………………. | Signature:  …………...……………… | Date:  ……..………… |
| Name of the Head of Department  …………………………………………………. | Signature:  …………...……………… | Date:  ……..………… |
| Name of the Head of Quality Assurance Committee/ School or Center  …………………………………………………. | Signature:  …………...……………… | Date:  ……..………… |
| Name of the Dean or the Director  …………………………………………………. | Signature:  …………...……………… | Date:  ……..………… |