**TEMPLATE FOR COURSE SPECIFICATION**

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

Course Instructor : Dr. Ziad Tark Abd Ali

**COURSE SPECIFICATION**

**Full knowledge of groundwater: definition, creation, characteristics, pollution, and some remediation methods**

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| 1. Teaching Institution | University of Baghdad/ College of Engineering |
| 2. University Department/Centre | Environmental Engineering Department |
| 3. Course title/code | Groundwater pollution |
| 4. Modes of Attendance offered | 1 day per week electronic |
| 5. Semester/Year | Year |
| 6. Number of hours tuition (total) | 60 h |
| 7. Date of production/revision of thisspecification | 2019 |
| 8. Aims of the Course |
| 1. Groundwater hydrology studies the movement of underground water in the saturated zone.
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| 1. Analytical solutions to the classic steady-state and transient flow problems in well hydraulics.
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|  3- - Understanding of physical factors controlling groundwater transport in porous media |
|  4- - Competence in applying simple analytical solutions of steady state and transient flow |
| 1. Many different methods ranging from institutional mandates to physical, chemical, and biological technologies have been proposed for the protection and/or cleanup of groundwater
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9· Learning Outcomes, Teaching, Learning and Assessment Method

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| A- Cognitive goals.

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| A1. After completing the course, students must have a clear idea of groundwater, its characteristics, underground transmission methods, and appropriate methods for treating contaminated groundwater |
| A2. Finding appropriate solutions to all kinds of groundwater problems  |

 A3. Attract and welcome undergraduate students to our Bachelor of Science program in Environmental Engineering, and to graduate B.S. students who are innovative problem solvers, who become leaders in their organizations, and who possess the knowledge and skills required for a wide range of careers and career changes. |
| B. The skills goals special to the course.

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| B1.Understand health and environmental issues related to groundwater |
| B2. The application of environmental concepts in the conservation of groundwater as an important water resource that must be preserved from contamination and resource recovery/recycling, transport. |

 B3.Concentrating on scientific research and its leading role in helping to serve the society and solving its problems through conducting application researches |
| Teaching and Learning Methods |
| More description of case studies and applications |
| Assessment methods |
| Homework related to problem solving  |
| C. Affective and value goals

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| C1. Developing environmental concepts, including the preservation of groundwater as an important water resource |
| C2. Spreading environmental awareness in the community and trying to contribute to the preservation of the environmentC3.Prepare students for successful careers in environmental engineering |

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| Teaching and Learning Methods |
| Intensive studies of regulations |
| Assessment methods |
| Case studies  |

D. General and rehabilitative transferred skills (other skills relevant to employability and personal development)

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| D1. Become more effective, independent and confident self-directed learners |
| D2. Improve their general skills for study and career managementD3. Articulate personal goals and evaluate progress towards their achievementD4.An ability to identify, formulate, and solve engineering problems |

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| 10. Course Structure |
| Week | Hours | ILOs | Unit/Module orTopic Title | TeachingMethod | AssessmentMethod |
| 1 | 2 |  | Introduction |  Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 2 | 2 |  | Porous media characteristics | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 3 | 2 |  | Porous media characteristics | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 4 | 2 |  | Groundwater definition | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 5 | 2 |  | Darcy’s Law | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 6 | 2 |  | Darcy’s Law | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 7 | 2 |  | Darcy’s Law | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 8 | 2 |  | Aquifer system | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 9 | 2 |  | Aquifer systems | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 10 | 2 |  | General flow equation and its solution | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 11 | 2 |  | General flow equation and its solution | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 12 | 2 |  | General flow equation and its solution | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 13 | 2 |  | General flow equation | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 14 | 2 |  | Steady radial flow to a well | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 15 | 2 |  | Steady radial flow to a well | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 16 | 2 |  | Steady radial flow to a well | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 17 | 2 |  | Hydraulic parameters measurement | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 18 | 2 |  | Hydraulic parameters measurement | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 19 | 2 |  | Groundwater contamination | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 20 | 2 |  | Groundwater contamination | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 21 | 2 |  | Ground water remedial technologies | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 22 | 2 |  | Ground water remedial technologies | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 23 | 2 |  | Ground water remedial technologies | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 24 | 2 |  | Transport of contaminants in pours’ media | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 25 | 2 |  | Transport of contaminants in pours’ media | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 26 | 2 |  | Advection dispersion relations | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 27 | 2 |  | Advection dispersion relations | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 28 | 2 |  | Advection dispersion relations | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 29 | 2 |  | Advection dispersion relations | Electronic | Questions during the lectures ,quiz, exam, present in the class |
| 30 | 2 |  | Advection dispersion relations | Electronic | Questions during the lectures ,quiz, exam, present in the class |

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| 11. Infrastructure |
| 1. Books Required reading: | 1. Unsaturated zone hydrology for scientists and engineers by James A. Tindall
2. Handbook of complex environmental remedeiation problems by Kevin John Phillips
3. Contaminants Hydrogeology by C.W.Fetter
4. Fundamentals of groundwater by Franklin W., Schwartz/Hubao Zhang
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| 2. Main references (sources) | Ground water by "Freeze" |
| A- Recommended books and references (scientific journals, reports…). |  |
| B-Electronic references, Internetsites… |  |

12. The development of the curriculum plan

The development could concentrate on more applications and mathematical modeling of groundwater remediation.