**Integrated Water Resources Management, Chemical Pollution of Water, and Methods of Analysis**

**Syllabus**

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| Discipline’s code | Discipline’s title |  | | | Number of ECTS | SWST  Self-work of student with teacher in hours |
| Lect. | Pract. | Lab. |
| 10 | Integrated Water Resources Management, Chemical Pollution of Water, and Methods of Analysis | 42 | 22 | 24 | 4 |  |

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| --- | --- |
| Academic presentation of the course | **Aim of course:**   * Understand and present the natural water (hydrological) cycle as part of the natural ecosystem using a diagram. * Understand the integration of natural and human systems in water resource use and management. * to help the stakeholders develop a working understanding of Integrated Water Resources Management (IWRM) which can translate into accelerated implementation and improved water resources management in different situations/areas ; * how to take the principles from IWRM into the softwares modelling tools for building decision support systems; * - to help understanding IWRM, ecosystem approaches and environmental flows to help understanding how can use technical instruments for analysis of chemical water pollution to master wastewater treatment techniques; * broaden your knowledge of international best practices in the field of multilevel water governance; * Explore cases studies of IWRM Implementation   **As a result of studying the discipline**, students should be able to:  1. acquire the knowledge, concepts and principles of integrated, multilevel water governance  2. to implement IWRM – the enabling environment, institutional roles and management instruments  3. to develop experience with water management and/or hydrology  4. to develop experience with softwares for IRWM implementation  5. to use instrumental techniques for analysis of chemical pollution of water  6. to know how apply techniques for waste water treatment |
| Prerequisites | Fluids Mechanics, Hydraulics, ECLD, Mathematics, Physics, Ecology, Chemics |
| Post requisites | Water management, risk management, modelling with different water applications softwares |
| Information resources | **Literature**:  1.Panaitescu Mariana- Hydraulic modelling and evaluation of surface waters with  environmental risk (Modelarea hidraulicã şi evaluarea apelor de suprafaţa cu risc de mediu), Nautica Publish House, Constanta, 2016  2. Panaitescu, M., Panaitescu, F.V., Hydraulics. Theories and applications (Hidraulică. Teorie si aplicatii), Nautica Publish House, Constanta, 2011.  3. \*\*\* Flood risk management plan-Dobrogea Litoral Water Basin Administration, pp.1-8, 2012.  4. Pătrașcu S., Rezumat Teză Doctorat – Evaluarea fizică a impactului climatic asupra extremelor hidrologice, Universitatea din București, 2008.  5. Popa, R., Elements of river hydrodynamics (Elemente de hidrodinamica râurilor), Didactic and Pedagogical Publishing House, R.A., Bucuresti, pp.253-300, 1997 .  6 Fread, D., Smith, G.F., Calibration technique for 1-D unsteady flow models.ASCE, Journal of the Hydraulics Division, vol. 104, no.HY7, 1978.  7. Courant, R., Friedrichs, K.O., Lewy, H., On the partial difference equations of mathematical physics, Math.Ann.vol.100, 1928.  8. \*\*\* Hydro-Informatics, Modelling tools MIKE 11, Part 1-Introduction, IHE 2001-2003.  9. Schumm, S.A., Lichty, R.W., 1965, Time, space and causality in geomorphology, Am. Jl. Sci., 263:110-119.  10.  \*\*\*ANCOLD guidelines on risk assessment. Position paper on revised criteria for acceptable risk to life. A.N.C.O.L.D. Working Group on Risk Assessment, 11 p., 1998  11.\*\*\*Bulletin on risk assessment: Risk assessment as an aid to dam safety management. I.C.O.L.D., 102 p.,1999  **Internet-resources:**  <http://documents.tips/documents/curs-hidrogeologie-generala.html>  <https://www.dhigroup.com/the-academy-by-dhi/course-description/surface-and-groundwater/overview/integrated-water-resources-management>  <https://www.un-ihe.org/online-course-iwrm-tool-adaptation-climate-change>  <https://www.mcgill.ca/osas/cpd/water-management>  <https://thehagueacademy.com/blog/2020/03/multilevel-water-governance-6/?gclid=Cj0KCQjw5auGBhDEARIsAFyNm9EQ8e6jwCsjA7wayTWyVbqg1ckAj7GeZhvyFRAeNycOUgzZ9cW-QQcaAjIqEALw_wcB>  <https://www.mikepoweredbydhi.com/download/mike-2020/feflow?ref=%7B60956B6F-0D4D-4843-81EF-F52BA72E6650%7D>  <https://www.mikepoweredbydhi.com/products/mike-eco-lab>  <https://manuals.mikepoweredbydhi.help/2017/General/MIKE_ECO_Lab_UserGuide.pdf>  <https://events.dhigroup.com/mike-eco-lab-online-course/> |

**Calendar (schedule) the implementation of the course content:**

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| Week / date | Topic title (lectures, practical classes, Independent work of students, IWS) | Number of hours | Maximum score |
| 1 | 2 | 3 | 4 |
| 1 | **Lecture 1.** Principles and practice of integrated water resources management (IWRM). | 2 | 10 |
| * Practical class 1. Integrated water resources management implementation aspects. | 2 | 10 |
| 2 | **Lecture 2.** Integrated water resources management and Climate Change. Concepts and approaches. | 2 | 10 |
| * Practical class 2. Climate change and adaptation options. | 2 | 10 |
| 3 | **Lecture 3.** Management  tools, models and  their application. | 4 | 10 |
| Practical class 3. How to take the principles from integrated water resources management into the softwares modelling tools for building decision support systems. | 6 | 10 |
| Lab 3. Presentation of a software modelling tools for IWRM. | 6 | 10 |
| **Self-work** of student with teacher: SWST.  *Theme and form of task*:  Demonstration and use of a location for IWRM application  Task:  -choose a location for implementation IRWM;  - description of water resource basin, transboundary water management and modelling. | 6 | 10 |
| 4 | **Lecture 4.** Climate change and adaptation options. | 2 | 10 |
|  | Practical class 4. Tools to implement IWRM – the enabling environment, institutional roles and management instruments. | 2 | 10 |
|  | Lab 4.Application to implement IWRM in a river basin | 2 |  |
|  | **Self-work** of student with teacher: SWST.   * *Theme and form of task*: Climate change, vulnerability and risk management. Establish challenges and set priorities using the Water Rapid Impact Assessment Matrix (RIAM)   Case studies. | 6 | 10 |
| 5 | **Lecture 5.** The principles from IWRM into the softwares modelling tools for building decision support systems | 6 | 10 |
|  | Practical class 5. Introduction in software FeFLOW for rivers. | 2 | 10 |
|  | Lab 5. Initiation in the use of software FeFlow tools | 4 |  |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*: FeFlow software applications | 10 | 10 |
| 6 | **Lecture 6.** Wastewater Treatment. Description of indicators of polluted water. Description of technological proceses from wastewater treatment plant (WWTP). Operational management of WWTP. SCADA softwares for monitoring operational proceses in WWTP. | 8 | 10 |
|  | Practical class 6 . Analysis of physico-chemical and bacteriological indicators of wastewater | 2 | 10 |
|  | Lab 6. Smart techniques for physico-chemical and bacteriological indicators for wastewaters | 4 | 10 |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*: Instrumental techniques for analysis of wastewater.  Simulation with SCADA the wastewater treatment proceses. | 10 | 10 |
| 7 | **Lecture 7.** Hydrology and Water Resources .IWRM, ecosystem approaches and environmental flows | 6 | 10 |
|  | Practical class 7. Uniform movements and gradual-varied movements in surface waters. | 2 | 10 |
|  | Lab 7. Calculation of the free surface curve in rivers | 2 | 10 |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*: Flows in the rivers. Case studies | 6 | 10 |
| 8 | **Lecture** **8**.Chemical pollution of water:  Hydrology and Water Resources Management  Water quality and water pollution control  Fundamentals of Urban Water Supply Management and Wastewater Management  Wastewater Treatment and Reuse in Agriculture. | 8 | 10 |
|  | Practical class 8. Aplication: Modeling a simple sewerage work | 2 | 10 |
|  | Lab 8.Tools for water quality and water pollution control. | 2 | 10 |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*:Softwares STOAT and GXP for simulation the WWTP flow. | 6 | 10 |
| 9 | **Lecture 9.** Methods of analysis | 8 | 10 |
|  | Practical class 9. Instrumental techniques.Photometer work.  Case study:Ammonia nitrogen. | 2 | 10 |
|  | Lab 9. Numerical Lab for Ecological and Agent Based Modelling | 2 | 10 |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*: basic knowledge about ecological modelling and ecosystems | 10 | 10 |
| 10. | **Lecture 10.** Cases studies of IWRM | 2 | 10 |
|  | Practical class 10. Case study | 2 | 10 |
|  | Lab 10. Case study | 2 | 10 |
|  | **Self-work** of student with teacher: SWST.  *Theme and form of task*: Applications of IWRM tools. | 4 | 10 |
| **Total** |  | L-42  P-22  L-24 | 10 |