

**Department: Civil & Environmental Engineering**

**Division: Civil engineering**

**Level and Major: Graduate - Water Resources Management and Engineering**

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**Course Title:** Advanced ground water

**Number of Credits: 3**

**Prerequisite (Corequisite): Structural analysis (I), Concrete Technology Lecturer: -**

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### **Course Topic**

- Generalities and basic concept(history, familiarity with types of porous media environment(unconsolidated, seam and slit karst)type of aquifer(free, under pressure ,leakage, local)and their features, history of ground water exploitation with emphasis on the Iranian infiltration tunnel system
- Introduction of modeling(continuum approach in porous media, hydrological cycle and ground water balance equation, ground water information and data and how to record them)
- Ground water flow concepts(concepts of porosity and hydraulic guidance and storage and passage of aquifers, incapability and heterogeneousness in aquifers)
- General equation of ground water flow (Darcy's law and its application in solving one – dimensional ground water flow problems ,Dupui assumptions –Horkheimer and its application in flow in free aquifers(
- Ground water flow analysis(general equation flow in pressurized and free aquifers application of flow equation in solving one-dimensional steady flow problems application of flow equation in solving one –dimensional unsteady flow problems, potential theory and flow net –two dimensional steady flow
- Hydraulic free aquifer well (well's hydraulic in steady flow ,wells hydraulic in unsteady flow, pumping tests and determining hydraulic properties of the aquifer well flow near the borders-image method
- Hydraulic well pressurized aquifer(well's hydraulic in steady flow, well's hydraulic in unsteady flow (Tais equation ,cooper- Jacob method, Java method ,regression method ,well's hydraulic in unsteady flow of leakage aquifer ,multiwell systems and incomplete wells
- Grand water pollution(natural quality of ground water ,ground water salinity and its resources ,physical ,chemical and biological features of ground water ,ground water pollution sources :urban, industrial and agricultural, soluble and insoluble ground water pollutants, LNAPL, DNAPL, methods of reducing and controlling ground water pollution)
- Analysis of ground water pollution(transfer-diffusion equation(advection-dispersion) of pollutants in ground water ,analytical solution of transfer-propagation equation)
- Ground water improvement (quantitative-qualitative monitoring on ground water ,methods of aquifer remediation with emphasis on pump and treat method
- Salt water invasion(types of salinity issues in aquifers and coastal and island aquifers ,Ghyben- Herzberg and Gavor equations in estimating interface ,salt and fresh water ,the effects of well in shape of interface (stoke equation),uplift of the interface due to pumping equation of interface in island aquifers ,methods of controlling salt water invasion)
- Referring to the numerical modeling of ground water (types of numerical models to solve flow equations and pollutant transmission ,limited difference method in solving the flow equation in steady and unsteady conditions, limited difference method in solving the transfer equation of pollutant, familiarity with MT3DMS and MODFLOW software and relevant soft ware packages and their applications

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