Course Plan

DEPARTMENT OF ENVIRONMENTAL SCIENCE

ES-568: Hydrogeochemical Processes **L2-T0-P0-CR 2**

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1. **Abstract**:

Introduction to hydrochemistry, with special emphasis on geochemical processes at low temperature. The student will attain an improved understanding for processes that control the composition of water in environments where water - mineral interactions dominate (e.g. in groundwater). Acid - base reactions in natural water, the carbonate system, oxidation and reduction processes, mineral precipitation and dissolution, and metal speciation.

2. Objectives:

The aim of the course is to deepen and develop the student's knowledge, skills and approach within the field of hydrogeology as a tool to manage and solve complex problems.

3. Prerequisites of the course:

Knowledge of chemistry like thermodynamics, chemical kinetics , chemical equilibrium etc. and geochemical processes.

Time-Plan for the course

Dates(Approx.)	Topics to be covered	Lectures
1-18 Aug	Catchment hydrology-The global system, fluxes, reservoirs, and residence times;	4
21-31 Aug	Groundwater transport - Water in natural formations (aquifer, aquitard, aquiclude etc); Hydraulic head; conductivity, permeability, storativity, and porosity, Darcy's law	4
7 Sept	**Test 1**	
11-15 Sept	Steady state groundwater flow & Flow nets, Tracer techniques.	3
19-26 Sept	Chemical Weathering- Clay mineralogy, Cation exchange and Carbonate mineral equilibrium ; Silicate weathering, Carbonate weathering ;Contaminant transport Adsorption processes; Hydrogeochemical processes and its role in contemporary environmental scenario.	2-3
	Mid-term exam	
10-24 Oct	Evaporation, condensation, precipitation; Regional water balances and resources; Precipitation and Interception; Water and energy balance, Subsurface flow; Infiltration and soil moisture; Hydrographs ; Remote sensing and hydrological networks;	4
26 Oct -9 Nov	Structure and properties of water ; Understanding of	5-6

	hydrogeochemical processes-Measurements and interpretation of water quality data; Identification of hydrogeochemical processes through Major ion chemistry, Graphical presentation and Statistical analyses; Groundwater flow and transport models; Modeling runoff and PhreeqC, MINTEQ-A	
	Test III	
15-23 Nov	Arsenic and fluoride hydrogeochemistry;	3
28-30 Nov	Desalination, Controlling demand and waste; Integrated water resources management; Case studies.	2
	End Term Exam	

Text Books:

1. Hornberger, G.M., Raffensberger, J.P., Wiberg, P.L., and Eshleman, K.N. (1998) Elements of physical hydrology. Johns Hopkins University Press, Baltimore, 302p.
2. Fetter, C.W., Applied Hydrogeology 4rd ed. (2001). This text will be supplemented by material from Freeze, A. and Cherry, J., Groundwater (1979),
3. Chow, V.T., Maidment, D.R. and Mays, L.W., Applied Hydrology (1988), Dingman, S.L., Physical Hydrology (1998).
4. Todd, D.K. Ground water Hydrology, John Wilay and Sons, N.Y.,USA.

(b) Evaluation plan

Performance of the student is evaluated on the basis of the following continuous assessment

Mid-term: 30 Marks

End term: 50 marks

Term paper/ unit test: 20 marks

Total: 100 marks

6. Pedagogy: Lecture method, Group discussion, Group presentation, assignment, etc.

7. Expected outcome: Upon completion of the course, the student shall be able to describe the major hydrogeochemical processes and parameters that control metal mobility in an aquatic system, quantify mass balance relations and thermodynamic reactions, explain the differences in water composition that are observed in the environment as a result of differences in soil, geology, climate and chemical reactions