

## Soil and Water Remediation

Fourth stage students of Soil and Water Department

Assist. Prof. Dr. Tariq F. Sadiq -- PhD in Environmental Soil Chemistry

Academic Year: 2023 - 2024

### Course Book

<b>1. Course name</b>	<b>Soil and Water Remediation</b>
<b>2. Lecturer in charge</b>	<b>Dr Tariq F. Sadiq</b>
<b>3. Department/ College</b>	<b>Soil and Water\ Agriculture</b>
<b>4. Contact</b>	<b>tariq.sadiq@su.edu.krd Tel: 009647504699925</b>
<b>5. Time (in hours) per week</b>	<b>Thursday 10:30 am-12:30 am</b>
<b>6. Office hours</b>	<b>Daily from 8:30 to 2:00</b>
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<b>My Name is Tariq F. Sadiq, I have Bsc in Soil and Water Science (Salahaddin Uni. 2006), Msc. in Soil Chemistry and Fertility (Salahaddin Uni. 2010) and PhD. in Environmental Soil Chemistry (UPM, Malaysia 2016). I'm a lecturer at Soil and Water Dept. Agriculture college.</b>
<b>9. Keywords</b>	<b>Remediation, Contamination , Hazards, Bioremediation,</b>
<b>10. Course overview:</b>	<p>This course consists of a study of the ways in which hazardous organic and inorganic materials can be removed or attenuated (reduced) in natural systems. The theory behind various technologies, with an emphasis on bioremediation techniques and their success in practice. An introduction to the unique challenges associated with the remediation of surface and ground water environments, soils.</p>
<b>11. Course objective:</b>	<p>The objective of this course is to provide an introduction to the theory and practice of soil and groundwater remediation to the fourth year soil and water department students.</p>
<b>12. Student's obligation</b>	<p>The student must have an important role:</p> <ol style="list-style-type: none"><li>1- Lecture and Lab attendance are compulsory.</li><li>2-The students must contribute in the scientific discussions in the class or teaching hall.</li><li>3-The students must know the importance of quizzes, homework, reports and exams.</li></ol> <p>It is necessary to contribute the student in presenting a scientific subject</p>
<b>13. Forms of teaching</b>	<p>There are different forms of teaching:</p> <ol style="list-style-type: none"><li>1-Datashow and power point.</li><li>2- White board.</li></ol>

3-Lectures.

**14. Assessment scheme**

The course degree was divided as follow %50 of monthly exam, % 15 for theoretical part 35% for practical part in theoretical part 5 marks for the first exam, 5 marks for second exam, 5 marks for daily quiz and preparing reports

Final exam takes %50 marks for theory part only

**15. Student learning outcome:** At the end of the course, you are expected to:

1. develop an understanding of the fate of contaminants in soil and groundwater.
2. have an introductory knowledge of the soil and groundwater remediation technologies.
3. be able to do basic calculations for the analysis of contaminant fate in soil and groundwater.
4. be able to do basic calculations for the analysis of the outcome of potential remediation technologies.

**16. Course Reading List and References:**

1. Evan K. Nyer (1998). Groundwater and soil remediation: practical methods and strategies.
2. Chelsea, Mich. Ann Arbor Press. Alok Bhandari ... [et al.]. (2007). Remediation technologies for soils and groundwater sponsored by Remediation Technologies for Soils and Groundwater Task Committee of the Environmental Council, Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers. Reston, Va.: American Society of Civil Engineers.
3. Ellen L. Kruger, Todd A. Anderson, Joel R. Coats (1997). Phytoremediation of soil and water contaminants. Washington, DC: American Chemical Society.
4. Juana B. Eweis (1998). Bioremediation principles. Boston: WCB/McGraw-Hill.
5. Franklin J. Agardy and Patrick J. Sullivan (2009). Environmental engineering. Water, wastewater, soil, and groundwater treatment and remediation. 6th ed. Hoboken, N.J.: Wiley.
6. Evan K. Nyer (1993). Practical techniques for groundwater and soil remediation. Boca Raton: Lewis Publishers.
7. Seever, William J. Lehr, Jay H. Hyman, Marve. (2001). Handbook of Complex Environmental Remediation Problems. McGraw-Hill Professional.
- 8.

**17. The Topics:**

**Lecturer's name**

1 <sup>st</sup> week Introduction to remediation 2 <sup>nd</sup> week Water pollution 3 <sup>rd</sup> week Remediation of water pollution1 4 <sup>th</sup> week Remediation of water pollution2 5 <sup>th</sup> week <b>First Test</b> 6 <sup>th</sup> week Soil pollution 7 <sup>th</sup> week Remediation of soil pollution1 8 <sup>th</sup> week Remediation of soil pollution2. 9 <sup>th</sup> week Bioremediation 10 <sup>th</sup> week <b>Second Test</b> 11 <sup>th</sup> week Phytoremediation 12 <sup>th</sup> week Class Presentations 13 <sup>th</sup> course review	Lecturer's name Dr. Tariq F. Sadiq ex: (2 hrs)
<b>18. Practical Topics (If there is any)</b>	
There are three main and important skills the students should learn, which are M. PowerPoint , M. Excel and M. Word that led them dealing with computer and internet	Lecturer's name ex: (3-4 hrs)
<b>19. Examinations:</b> <b>1. Compositional:</b> 1-Definition? 2-explanation? 3- What are the differences between A and B? 4- Fill-in the blanks?  <b>2. True or false type of exams:</b>	
<b>20. Extra notes:</b>	
<b>21. Peer review</b>	پیداچوونہوہی ہاوہل

**The Course schedule and contents are tentative and may be subject to change**

## Introduction

Prior to the enactment of modern environmental regulation, many companies simply released hazardous materials into the environment. They would dump chemicals and other pollutants onto unused land or into lakes, rivers, and streams. Sites also would become polluted through accidents or improperly functioning equipment. Polluted sites that can be cleaned and redeveloped are known as **brownfield sites**.

**Brownfield land** is any previously developed land that is not currently in use that may be potentially contaminated. The term is also used to describe land previously used for industrial or commercial purposes with known or suspected pollution including soil contamination due to hazardous waste. This term is often used in contrast to "**greenfield land**," which refers to undeveloped land, typically agricultural or natural areas.

### What is pollution?

- Pollution is defined as the excess discharge of any substance into the environment which affects adversely quality of environment and causing damage to humans, plants and animals.
- Environmental pollution by chemical (organic and inorganic) pollutants has become a serious problem in the world. Pollutants mostly result from various human activities like the manufacturing, handling, storing, and disposing of chemicals.
- Pollution is explained as any substance introduced into the environment that adversely affects the usefulness of resources.
- Pollution can be in the form of solid, liquid or gaseous substance.
- Pollution causes damage to human, plant and animal life.
- The nature and concentration of pollutant determine the severity of effect of pollution.

### Types of Chemical Pollutants

Types of Chemical Pollutants Based on their chemical structure, chemical contaminants can be classified into naturally occurring and man-made categories. They can be organic

or inorganic (organic compounds always contain carbon and carbon-hydrogen bonds, whereas most inorganic compounds do not contain carbon).

**Organic Chemical Pollutants are produced by living organisms or are based on the matter formed by living organisms.**

1. Crude oil and petroleum refined products (gasoline, diesel fuel, kerosene, mineral spirit, motor oil, lubricating oil);
2. Solvents (acetone, MEK, toluene, benzene, xylene) used in industry and household products;
3. PAHs (polyaromatic hydrocarbons) are found in petroleum products, crude oil, and as a result of burning activities in coal power plants, historical manufacturing gas plants, etc.;
4. PCBs (polychlorinated biphenyl ethers), which are now banned, but were commonly used in transformers, so they are already present in large amounts in environment;
5. Alcohols are used in a large variety of applications and household products;
6. Trihalomethanes (chloroform, dibromochloroform, bromoform) which are common products of water chlorination;
7. Phenols are usually an indication of waste water and a result of industrial processes;
8. Plastics like bags, bottles, and containers are a result of industrial processes;
9. Pesticides / Insecticides / Herbicides are commonly used in agriculture and may contain toxic organic chemicals and metals (such as mercury and arsenic);
10. Detergents (e.g., nonylphenol ethoxylate) include a variety of chemical compounds with surface activities.

**Inorganic Chemical Pollutants are those chemicals of mineral origin that are not produced by living organisms.**

1. Metals and their salts – usually resulted from mining activities and disposal of mining waste; Examples: metals (Pb, Cd, Zn, Cr, Hg), metalloids (Se, As) and radionuclides (Cs, U)
2. Inorganic fertilizers (nitrates, phosphates) used in agriculture and gardening; when present in large amounts in water, they can be harmful to humans and algae;
3. Sulfides (pyrite) are used in mining and can generate sulfuric acid if combined with rainwater and microorganisms;
4. Ammonia is a poisonous gas that in higher amounts and can cause blindness followed by death;

5. Acids and bases are used in some industrial applications and in chemical laboratories. If spread in large amounts, they pose a serious threat to the environment;
6. Perchlorate is used in rocket fuels, explosives, military operations, fireworks, road flares, inflation bags, etc. Perchlorate is problematic because it is a persistent gas that can damage thyroid functions in humans.

**Ecologically, pollutants can be divided into three types:**

**1. The Degradable or called as non-persistent pollutants.** The pollutants that can be rapidly decomposed by natural processes is called degradable or non-persistent pollutants. For example, domestic, sewage, discarded, vegetables, etc.

**2. Slowly degradable or persistent pollutants.** Some pollutants remain in environment for longer time because they decompose very slowly by the natural processes. Example: plastics, pesticides, etc.

**3. Non-degradable pollutants.** Some pollutants cannot be decomposed by natural processes are called non-degradable pollutants. Example – Lead, mercury, etc.

**What is remediation?**

- Remediation is the act of correcting (Cleaning) an error or stopping something bad from happening. or
- Remediation is the return of an area or component to as natural a condition as possible (e.g., contaminated water and soil).
- Environmental remediation is the removal of pollution or contaminants from water (both ground water and surface water) and soil.
- Water remediation is the process of removing contaminants from water.
- Soil remediation is a way of purifying and revitalizing the soil. It is the process of removing contaminants in order to protect both the health of the population and the environment.

These waste products are removed for the protection of human health, as well as to restore the environment. Remediation restores brownfield sites either for redevelopment or to return them to their natural state.

Environmental professionals use a number of technologies to clean up polluted sites, a process known as environmental remediation.

