

# CE 442

## Water and Wastewater Treatment

### Department of Civil Engineering King Saud University

<p><b>Course Description:</b> <b>CE 442 Water and Wastewater Treatment</b> (Required for a BScE degree)</p>	<p>Fundamental principles and current practices in water processing, municipal wastewater treatment, and sludge processing. Characteristics of surface and ground waters, and municipal wastewater. Concepts and design of different unit operations and processes for the treatment of water/wastewater. Drinking water standards. Wastewater reuse and disposal criteria. Properties of sludge generated from treatment processes, treatment and utilization. Laboratory experiments related to water and wastewater quality and quality control. Field trips to water/wastewater treatment plants. 3(3,0,2)</p>
<p><b>Prerequisite</b></p>	<p>CE 322 (Hydraulics); CHEM 101 (General Chemistry). Topics:</p> <ol style="list-style-type: none"> <li>1. Hydraulic and energy grade lines.</li> <li>2. Fluid flow characteristics, and types of flows</li> <li>3. Drag on immersed bodies.</li> <li>4. Pumps and blowers.</li> <li>5. Elements, radical, and compounds.</li> <li>6. Standards solutions.</li> <li>7. Chemical equilibria.</li> </ol>
<p><b>Course Learning Objectives</b></p>	<p>Students completing this course successfully will be able to:</p> <ol style="list-style-type: none"> <li>1. Understand the engineering and science principles for the design of water and wastewater treatment systems,</li> <li>2. Design water/wastewater treatment facilities,</li> <li>3. Understand the operation and maintenance aspects of water and wastewater treatment units,</li> <li>4. Measure different physical, chemical, and microbiological parameters of water and wastewater.</li> <li>5. Conduct laboratory experiments to determine chemical requirements and assess performance aspects for different water and wastewater processing means.</li> </ol>
<p><b>Topics Covered</b></p>	<ol style="list-style-type: none"> <li>1. Water Chemistry and Analysis (3 hours)</li> <li>2. Water Quality Parameters and Measurements (11 hours)</li> <li>3. Water Sources and Quality, and Drinking Water Standards Wastewater Disposal and Reuse Criteria (2 hours).</li> <li>4. Water Treatment Processes: treatment objectives, coagulation and flocculation, sedimentation, filtration, softening, iron and manganese taste and odor control, demineralization (RO), chlorination, chloramination, ozonation, control of disinfection by-products, (12 hours)</li> <li>5. Wastewater Treatment Processes: characteristics and composition of municipal wastewater, wastewater treatment objectives and effluent requirements/standards, preliminary treatment (screen, shredders, grit chambers, equalization), primary treatment (primary clarification), secondary treatment (biological filtration, activated sludge, oxidation ponds) (10 hours).</li> <li>6. Wastewater Reclamation &amp; Reuse (2 hours)</li> <li>7. Characteristics and Treatment of Water/Wastewater Sludge (5 hours)</li> </ol>
<p><b>Class Schedule</b></p>	<p>Class is held three times per week in 50-minute lecture sessions. There is also a 2-hr weekly laboratory session.</p>
<p><b>Treatment Plants Visits</b></p>	<p>A visit to a water purification plant is arranged at the mid of the term, and another visit is made to a wastewater treatment plant at the end of the term to visualize full-scale treatment facilities, and relate real them to course content. A written report is required for each visit.</p>

<b>Laboratory Experiments</b>	<p>For each laboratory session, students are divided into groups of 3 – 5 members to carry out experiments. Where several tests are done concurrently, students should coordinate themselves to perform test and analysis in designated time. Each student will submit a separate report.</p> <p>Experiments on water and wastewater consists of the following exercises:  Measurements of chloride, sulphate, pH, conductivity, turbidity, total dissolved solids, suspended solids, volatile solids, dissolved oxygen, alkalinity, hardness, total and fecal coliforms, biochemical oxygen demand, chemical oxygen demand, and ammonia and total nitrogen. Chlorine demand test and jar test are also conducted.</p>
<b>Contribution of Course to Meeting the Professional Component</b>	<ol style="list-style-type: none"> <li>1. The course prepares students for designing water and wastewater treatment processes.</li> <li>2. The course enables students to design and conduct experiments related to water and wastewater quantity and quality control, and analyse and interpret results.</li> <li>3. The course equips students with knowledge and experience to develop alternative solutions and methods for different water pollution problems.</li> <li>4. The course enhances students ability to articulate ideas clearly in written and verbal forms.</li> </ol>
<b>Relationship of Course to Program Outcomes</b>	<p>This course will allow students to:</p> <ol style="list-style-type: none"> <li>1. Utilize knowledge in mathematics, chemistry, physics, and microbiology to understand the characteristics of water and wastewater and the principles of processing of water, wastewater and resultant sludges.</li> <li>2. Apply scientific knowledge for the selection and design of treatment processes.</li> <li>3. Design different unit operations and processes for the treatment of water, wastewater, and sludges.</li> <li>4. Offer solutions to problems related to treatment of water and wastewater (e.g. type and degree of and treatment, operational problems of treatment processes).</li> <li>5. Conduct laboratory experiments related to water and wastewater quality and process design.</li> <li>6. Appreciate and understand responsibilities towards their roles in the design, operation, and maintenance of water and wastewater treatment systems.</li> <li>7. Write reports on laboratory experiments to present, interpret and discuss results and make sound conclusions.</li> <li>8. Study and deal with any issue related to contemporary water and wastewater treatment techniques.</li> </ol>
<b>Textbook(s): Other Supported Material:</b>	<ol style="list-style-type: none"> <li>1. Hammer, M. J. and Hammer, M. J. Jr. "Water and Wastewater Technology" 6<sup>th</sup> edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey (2007).</li> <li>2. Metcalf &amp; Eddy, "Wastewater Engineering: Treatment and Reuse", 4th Edition or later (2003 or later)</li> <li>3. APHA, AWWA, and WEF. "Standard Methods for the Examination of Water and Wastewater", 20<sup>th</sup> edition, APHA, Washington, DC. (1998).</li> </ol>
<b>Prepared by</b>	Dr. Waleed M. K. Zahid
<b>Date of Preparation</b>	May 10, 2006
<b>Date of Preparation</b>	Oct, 2009. Prof. sharaf Refaat; Dr. Waleed Zahid

#### Grade Distribution

Mid-term Exams:	30%
Laboratory and Visit Reports:	20%
Homework:	10%
Final Exam:	40%

#### Homework and Reports

Homework and laboratory and visit reports must be done independently and submitted on time. Late submission will be penalized. Submission must be neat and clean on A4 paper.