

**CIVE 532 – Syllabus**

**Course number and title:** CIVE 532 – Groundwater Wells and Pumps

**Credits:** 3

**Term(s) to be offered:** Spring 2015

**Prerequisite(s):** CIVE 423, (CIVE531 or GEOL 452), MATH161, CHEM111 (exceptions by instructor)

**Course Description:** This is an advanced undergraduate and graduate level course focusing use of wells and pumps for developing groundwater resources, and subsurface remediation. Much of the course material is also applicable to production of oil and gas. Primary topics include, well field hydraulics, well drilling methods, well design (gravel pack-well screens-casings), aquifer test methods, pumping systems, well maintenance, cost analyses, surface storage/distribution systems, and conjunctive use of surface and groundwater.

**Instructor:** Tom Sale – Associate Professor/Civil and Environmental Engineering

**Text:** Sterrett, Robert (2007), Groundwater and Wells, 3rd Edition: A Comprehensive Guide for the Design, Installation and Maintenance of a Water Well, Smyth Companies, Minnesota, USA.

**Additional Class Material:** Handouts, PowerPoint presentations, and worksheets provided by the instructor.

**Course Objective(s):** At the conclusion of this course, students will be familiar with

- Subsurface drilling techniques
- Tools used to characterize subsurface condition
- Design of well fields
- Design of well screens, casing, and seals and related well completion techniques
- Methods of well development, aquifer stimulation (including fracing), and maintenance
- Selection of pumps and ancillary controls
- Development of contractor bid packages and analysis of costs
- Use of MathCAD to conduct design calculations

**Course Topics/Weekly Schedule:** This class will meet twice a week. All lectures and/or presentation material will be posted to a class folder. Teaching will involve a combination of lecture and discussion with supplementary readings, and guest speakers.

**Instructional Methodology:** Lecture, Reading, Homework, Field Trips.

**Mode of Delivery:** Classroom Instruction

**Methods of Evaluation:** Midterm (30%), Final (30%), Homework (30%), and Field Trips and Class Participation (10%).

Term grades for this course will use the +/- grading system as described in the CSU catalog. The following scale will be used: A  $\geq$  93; A-  $\geq$  90; B+  $\geq$  87; B  $\geq$  83; B-  $\geq$  80; C+  $\geq$  77; C  $\geq$  70; D  $\geq$  60; F < 60

## **COURSE OUTLINE**

### **Introduction (1-week)**

- Course objectives, content, and grading**
- Review of critical hydrogeologic principles**
- Hydrogeology**

### **Wellfield Hydraulics (2-weeks)**

- Systems for groundwater production and delivery**
- Analytical solutions for wellfields**
- Aquifer test methods**

### **Drilling Methods (2-week)**

#### **Vertical wells**

- Excavation**
- Direct push**
- Mud rotary**
- Air rotary**
- Sonic**

#### **Horizontal wells**

- Borings**
- Trenching**

### **Well Design (2-weeks)**

- Gravel pack, Well screens, Casings,**
- Well development**

### **Pumping Equipment (2-week)**

- Types of pumps**
- Sizing systems**

### **Well Maintenance (1-week)**

- Monitoring methods**
- Well rehabilitation**

### **Cost Analyses (1-week)**

- Capital**
- Operations**
- Maintenance**

**Surface Storage/Distribution Systems (1-week)**

**Storage**

**Distribution**

**Conjunctive Use of Groundwater and Surface Water (1-week)**

**Conventional well fields**

**Aquifer storage-recovery systems**