Geography 470 (Engineering I)
Soil and Water Engineering
Fall Term, 2005
Dr. Craig Caupp

**Catalog Description**
2206.470, Principles and methods for soil and water management related to surface land disturbance. Methods for calculating storm runoff and erosion, design of flow conveyances and water detention basins, and computer assisted modeling. Three hours of lecture and one 2-hour lab period each week. Prerequisites: 6 credits of mathematics, or permission of the instructor.

**Purpose:** This course will teach engineering techniques for calculating peak runoff, flood hydrographs, conveyance design and storage detention basins. These engineering techniques will be learned by solving applied hydrology problems. Many of the projects will be group projects. Each lab will require a written report. Many reports will require graphs illustrating the results.

**Course Objectives**

1. Learn to evaluate the factors influencing erosion, on-site stormwater management and sedimentation.
2. Obtain an understanding of the importance of erosion and sediment control.
3. Obtain an understanding of the basic engineering principles related to the application and construction of water diversion structures and impoundments.
4. Design diversion ditches, dams and sediment ponds.
5. Develop an understanding of methods used to calculate runoff, soil erosion, and hydraulic equations for open channel flow and pipes.
6. Obtain experience working with computers to solve problems. Experience with the computer will include working with spreadsheet and programs used to calculate runoff.
7. Apply concepts of applied hydrology to analyze watershed condition.
8. Learn to use TR-55 to calculate peak flow, flood hydrographs, and route flows through detention basins. (DOS TR-55, WinTR55, and Win Tr-20)
9. Learn to manage storm water management project:

- Collect watershed data from topographic maps and soil surveys.
- Input data into programs to calculate runoff.
- Learn to apply hydraulic equations for designing culverts and ditches. (learn HY-8)
- Learn to design retention/detention basins, sizing basins, routing flow through the basin.

10. Learn to use **AUTOCAD** to digitize watersheds and soil surveys.
11. Become proficient with spreadsheets for calculations, data management and graphing.

**Goal:** Students will become familiar and proficient with several computer programs. Computer programs will be used as tools in the course, word processor programs will be used to prepare reports; calculations, graphing, and data management will be done in a spreadsheet. The TR-55 computer program will be used to calculate peak flow. AUTOCAD will be used to digitize maps. The AutoCad Land Development program will be used to demonstrate integrated programs currently in use in engineering offices.

**Study Hint Warning:** **Do not fall behind**. The lab material builds from one week to the next. If you are one week behind, twice the work will be required to finish the current weeks project, if you are three week behind three times the work will be required. Late projects are accepted with **points taken off for being late**. The greatest penalty for getting behind on projects is the lost, sinking feeling of having no clue as to what is going on in class or lab. Many of the computer software programs will be new to you and will require some experimentation. There will likely be some frustrating times working on the computer programs. These programs will require time spent learning their commands. This is the first year the Eagle Point Software has been used. Expect some delays and problems while getting this package up and going. Working in groups is a necessary skill for dealing with engineering projects. Projects will require working together as an effective group. Many of the projects can only be done on time by dividing up the work within a group. Groups will be assigned by the instructor. Individual reports will be required. **Calculators**

**and handout material should be brought to class each session**. Calculators will be used during the lecturers and often short problem sets are assigned to be finished during the lecture period. Tests are open book, open notes.

**COURSE OUTLINE**: Given on separate sheet.

**TEXT**

"Hydraulics and Hydrology for Stormwater Management", John E. Gribbin. Delmar Publisher, 2002 (cited as #1 in outline).
"Storm Water Management Design Manual for Frederick County, Maryland" (cited as 2 in reading assignments)
"TR-55 Manual," SCS..(cited as 3 in reading assignments)
"Urban Surface Water Management", 1989, Stuart G. Walesh, Wiley Interscience. (suggested but **not required**).
Sections of Maryland's new Stormwater Management Manual will be provided.

**EQUIPMENT:** Calculator, colored pencils, floppy disks, and engineering scale

**COURSE EXAMINATIONS**:The exams include questions from your text readings, lecture notes, and lab exercises. Types of questions include multiple choice, matching, fill-in-blank, short answer essay, and design problems. The tests will be very similar to the projects. The tests will be given during the lab periods or as take home tests.

Three exams will be given. The first exam will occur in the fifth or sixth week, the second in approximately the tenth week and the last during the scheduled final exam period. Make-up exams will be given only if the student is ill or a personal emergency occurs. The absence must be reported to the instructor prior to the examination period and supported by proper written documentation.

**GRADES** -- determined by total points accumulated:

| | | |
|---|---|---|
| Exam 1 | 100 | A = 450 or more |
| Exam 2 | 100 | B = 400 to 449 |
| Final Exam | 125 | C = 350 to 399 |
| Lab | 175 | D = 300 to 349 |
| | | F = 299 and below |
| | 500 | |

**Late exercises.** Homework and lab exercises are expected to be on time. A grace period of 1 day is allowed. After 1 day 5% per day will be taken off until 10 days passes when they will no longer be accepted.

**ATTENDANCE POLICY** : Attendance will not be taken. Students assume responsibility for information and handouts missed due to absence. Lab exercises are expected to be done on time. Lab exercises missed due to absence will not be accepted.

**OFFICE: GU 205 (ext. 4755)** Hours I have an open door office policy, stop by with your question at any time. **Office Hours:** Tue, Thur 9:30 - 10:30 AM., Wed 2:00-4:00, Friday 12:00-1:00.

**ACADEMIC DISHONESTY:** is defined to include giving or receiving aid on exams, any form of cheating, or plagiarism. Students found guilty of academic dishonesty will receive an automatic course grade of "**F**" and will be referred to the Campus Judicial System. For a discussion of Academic Dishonesty refer to statement in the Student Handbook.

Disruption of class or any behavior in class which interferes with an effective learning environment will not be tolerated, and will result in expulsion from the classroom. Please consult the Pathfinder

# Tentative schedule for Geography 470 Fall 2005

new software HEC-RAS AutoCad 2006, new state manual, so there could be at least one change in the following, keep tuned for changes on the fly)

Week 1

Introduction, use of Manning's equation
Lab 1 use of Manning's equation, spreadsheet review
Readings in text page 102 – 107
Frederick County manual Manning's equation and channel design sections

Week 2

CN calculations and intro fluid dynamics
Readings in text Chapter 1, Engineering design, Significant figures problems page 13 #s 1,2,3,4,6,7,10.
Readings in text pages 15 – 19 problems page 21 1,2
Readings in text Chapter 3 hydrostatic pressure
Readings in text Chapter 4 Energy Head, Conservation of Energy and mass pages 49 – 58
Lab II CN calculation TR-55 manual CN section and introduction to AUTOCAD
Problems page 92 #s 1, 2, 3, 5, 8, 9, 10, 11
**Due Lab report for Lab 1**

Week 3

Fundamental Hydrology, surface runoff
Reading in Text Chapter 8 and 9
Lab III Delineation of drainage basin and Tc calculation (no report required for this lab)
Lab III consisted of problems from text
Page 166 #s 3,5,7 page 174 #s 9,11,13 page 214, # 16
Hand in answer to problems, map showing basin and flow paths, calculations and any assumption made.
**Due Week 2 problems from text**
**Due Lab report for Lab II**

Week 4

SCS method of calculating peak discharge, Tc calculation
Readings Chapter 8 and 9 in Text and Chapters 1 through 4 in the TR-55 manual.
Lab IV Runoff Calculation using base map from Lab 1 Report required

Week 5

**DUE Draft Lab III problems and maps need results done**
**Due Draft Lab IV report**
Preparation of runoff hydrograph using Tabular method in TR-55, use of DOS and Windows versions of TR-55.
Lab V (report required) Calculation of runoff hydrograph, watershed delineation, CN calculation, Tc calculation and use of DOS and Windows version of Tr-55. Do you get the same results from both techniques? (Lab V uses results from Lab III and Lab IV)

Week 6

**DUE Lab III problems and maps need results done**
**Due Lab IV report**
**Test 1**
Culvert Hydraulics and design
Readings text Chapter 7 and Chapter 11
Frederick County manual pages 7-1 to 7-26.

Lab VI Collection of field data necessary to size culvert crossing Sands Springs on Loop road.
Problems page 138 #s 1, 3, 7, 9, 10, 11 page 312 #s 2, 3

Week 7

Continue Culvert Design, Stream Cross Section, HEC-RAS
Lab VII Culvert design and evaluation of existing culvert adequacy for the Sands Springs Culvert.
**Due report for Lab V**

Week 8

Detention base design
Readings text chapter 12, problems page 376 #s 1,2
**Due Culvert problems**
Lab VIII Estimation of required storage basin size

Week 9

Routing of flow through detention basin Problems page 376 #s 3,4
**Due Lab VII report**
**Due Lab VIII report**
Lab IX Detention basin design, Problem 5 page 378

Week 10

Use of TR-20
Take home Test

Week 11

**Due Lab IX** report
**Due take home test**
Lab X Use of TR-20 to calculate Flow from Lab VII and Lab IX

Week 12

2000 Maryland Stormwater Design Manual
**DUE Lab X**
Lab XI Application of TR-55 and TR-20

Week 13

Due Lab XI report
Use of AutoCad Land Development package
Lab XII Design problem from 2000 Maryland Stormwater Design Manual
**Due Lab XI report**

Week 14

Floodplain Estimation
Lab XIII Problem #20 page 122 and Sands Springs example.
**Due Lab XII report**

Final Dec 12 Monday, 11:15 - 1:45

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Topic to be covered as time permits

1. **What** Water Engineering, Urban Hydrology, Applied Hydrology
    a. Movement of Water
    b. Amount
    c. Quality
2. **Why**
    a. Importance of Water
    b. Too Much
    c. Too Little
    d. Poor Quality
    e. Legislation
        i. Storm Water Management
            (1) state code
        ii. Flood Plain
        iii. Wetlands
        iv. Waterways
3. **How**
    a. Conveyance
        i. Swales
        ii. Ditches
        iii. Culverts
        iv. Storm Sewers
    b. Storage
        i. Ponds (detention/retention facilities)
        ii. On Site
        iii. Ditches
    c. Runoff Management
4. **Calculating Runoff**, Peak Flows, Total amount, Flood Hydrography , and Routing
    a. Hydrologic cycle
        i. Factors affecting surface runoff
        ii. Groundwater recharge
    b. Delineation of Watershed
    c. Soils --- Hydraulic Soil Group
    d. Land use
    e. Flow Paths --- Travel Time
5. **Methods** for Calculating Peak flow and hydrography
    a. Rational Method (Peak Flow Only)
    b. TR-55 Soil Conservation Service Urban Hydrology unit hydro
    c. TR-20
    d. HEC-1 Flood Hydrography Package
    e. HEC-2 Water Surface Profiles
    f. Eagle Point Software
    g. AutoCad Land Development package
6. **Impacts** of Urbanization
    a. Peak Flows
    b. Total Flows
    c. Groundwater

d. Soils, sedimentation, Universal Soil Loss Equation
e. Nonpoint pollution

7. **Sediment** Control
   a. Factors influencing sediment transport and deposition
   b. Calculation of sediment volume
   c. Sediment Control Measures
   d. Dams
   e. Embankments
   f. Spillways
   g. Gabion
   h. Crib
   i. Stone check
   j. On-site detention Ponds