COURSE SUMMARY

INRA Elective Course: SUBSURFACE CONTAMINANT BIOREMEDIATION

An asynchronous, 3 cr, graduate level course offered Fall semester 2004.

- First week of class 30 August- 03 September 2004
- Last week of class 06-10 December 2004

Instructor: **Dr. Al Cunningham,** Professor of Civil Engineering, Montana State University, e-mail al_c@erc.montana.edu , voice: (406) 994 6109. Additional tutorial materials have been contributed by Dr. **Bill Apel**, Idaho National Engineering and Environmental Laboratory, and **Dr. Ryan Jordan**, Center for Biofilm Engineering, Montana State University. Website and modeling software design have carried out by **Dr. Rocky Ross** and **Frances Goosey** of the MSU Computer Science Department.

Important Request*: If you are considering signing up for this course please contact Dr Al Cunningham via e-mail or voice mail. It is very important for us to identify the course enrollment prior to the close of spring semester 2004. Thank you.*

Course Description: This 3-credit course will be offered to graduate students from subsurface science-related disciplines. This course will be taught asynchronously using text books supplemented by web-based tutorial material supplied by the instructor. Communication between students and instructor will be set up via e-mail and conference call. The goal of the course is to provide students from multiple disciplines with a fundamental understanding of the subsurface processes, both biotic and abiotic, which contribute to the bioremediation of common subsurface contaminants including petroleum hydrocarbons and chlorinated solvents. Subsurface bioremediation is controlled by abiotic processes including multiphase flow, convective mass transport, adsorption/desorption, and phase partitioning, as well as biotic processes, such as microbial biomass growth and contaminant metabolism. Three interactive spreadsheet-based models (including EQUILIBRIUM PARTITIONING MODEL, BIOSCREEN and BIOCHLOR) will be used in this course for self-directed problem solving and concept demonstration. These models will serve as tools for in-depth quantitative demonstration of the interactions among various bioremediation-related processes (see Course Syllabus for specific topics covered in this course).

Recommended Prerequisites: Graduate standing in a discipline related to subsurface science, basic understanding of concepts in Chemistry, Organic Chemistry, Microbiology, and Flow Through Porous Media. Experience with Microsoft Excel spreadsheets.

Course Material Access: The course materials will be available at the following web site: **www.cs.montana.edu/webworks/projects/Bioremediation/Contents.htm**. A CD containing these same materials is included along with instructions for installation on an Intel-based PC. Accessing the course from the CD will avoid long download times due to slow internet connections.

Software requirements: Your PC must have the following software installed, operating system Windows 98 or higher, Netscape 4.79 or MS Internet Explorer 5.x or higher, MS Excel 97 or higher, and JAVA 1.4.0_01 run-time plug in (will be supplied on CD).

Method of Delivery: This course will be delivered asynchronously. Students will access all materials via the Internet or CD-ROM, along with material from two text books. The annotated tutorials provided in the course materials consist of diagrams, figures, graphs, etc. which are followed by written explanations of relevant concepts. These tutorials have been prepared for subjects not covered by textbooks. These sessions will concentrate on orientation issues, discussion of topics related to written homework assignments and question-and-answer sessions on course content.

Communication between Instructor and Students: The mostly likely method of communication will be via e-mail (chat room) together with periodic conference calls.

Textbooks: The textbooks used will be: Natural Attenuation of Fuels and Chlorinated Solvents (Wiedemeier et al., John Wiley and Sons, 1999, ISBN 0-471-19749-1, approx. $145.00), and Contaminant Hydrogeology (C. W. Fetter, Prentice Hall, 2nd ed., 1999, ISBN 0-13-751215-5, approx. $95.00). Students are responsible for obtaining text books prior to beginning of semester.

Systems Requirements: The main teaching and learning resource for this course is all on the accompanying CD. It includes an interactive model called the Equilibrium Partitioning Model (EPM). In order to use this CD to access the EPM model, the computer used must meet certain specifications. We have tested the software on the following.

- An Intel-based PC running Windows 98 SE, Windows 2000, or Windows XP
- Internet Explorer 5.0 or higher, or Netscape 4.79 (printing for the Equilibrium Partitioning Model may not work from the browser in other versions of Netscape).

Prior to using the course software the user needs to install (or check whether it is already installed) Java 1.4.0_01 run time environment. This is included on the CD. Two other spreadsheet models are included on the CD. These require that a recent version of Excel be installed on the computer as well.

Requirements for Course Completion: Each student will receive course materials at the beginning of the term. These materials will include 1) a Course Syllabus identifying the topics and the schedule for completing them, 2) an 8-page workbook containing all written (homework) assignments for Module I, and II), the CD-ROM containing the course materials and models. Homework assignments will be coordinated with the syllabus topics. Students will submit a completed homework notebook to the instructor (via surface mail) along with each examination. Examinations will be sent to the students by surface mail, completed in an established time period, and mailed back to the instructor, along with written assignments for grading. The written home work assignments will count for 50% of the course grade and the 2 examinations will count for 50%.