

**Western University - Faculty of Engineering**  
**Department of Civil and Environmental Engineering**

**CEE 2219b – Computational Tools for Civil Engineers –**  
**Course Outline 2015/16**

This course introduces computational tools and numerical methods for environmental and civil engineering analysis. The course emphasis is placed on problem formulation, solution algorithm designs and programming applications. The general objectives are for the student to become able to:

- solve problem sets relevant to civil and environmental engineering through problem formulation, solution algorithm design and programming application;
- identify and apply appropriate numerical methods for solving sets of linear and nonlinear algebraic equations, ordinary differential equations, and differential-algebraic systems;
- apply finite difference methods for the solution of differential equations;
- understand terminology of systems analysis and systems approach as a general problem solving technique for engineering planning, design and operations;
- formulate engineering problems using systems approach and optimization;
- develop awareness of the shortcomings, approximations and uncertainties associated with numerical methods and modeling;
- improve computational skills and be proficient in programming language required to solve engineering problems; and
- recognize the need for life-long learning, and advancement of computational skills for solving complex civil and environmental engineering problems.

**Calendar Copy:**

A first course in numerical methods for civil and environmental engineers, emphasizing problem formulation, solution algorithm design and programming application. Methods for solving nonlinear algebraic equations, ordinary differential equations, and differential-algebraic systems. Introduction to the systems approach, and system analysis terminology, for application to engineering planning, design and operations. (0.5 course)

**Contact Hours:**

3 lecture hours/week; 3 computer lab/tutorial hours; (recommended additional personal study, 3 hours)

Attendance at the computer lab/tutorial session is **mandatory**.

**Prerequisites:** ES 1036A/B, Applied Mathematics 1411A/B, Applied Mathematics 1413.

**Corequisites:** Applied Mathematics 2411 or 2415.

**Antirequisites:** CBE 2291A/B, the former CEE 2218A/B.

**Note:** It is the **student's responsibility** to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the **student's responsibility** to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

**Instructor:**

Angela Peck, SEB 3112, email: apeck3@uwo.ca.

Administrative Support: Civil and Environmental Engineering Department, Room 3005

**Textbook:**

Chapra, Steven C, 2008, *Applied Numerical Methods with Matlab for Engineers and Scientists, 3rd Edition* (Required). Lecture presentations and other material may be downloaded from the course website (<http://owl.uwo.ca>).

**Other References:**

Bilal M. Ayyub, Richard H. McCuen, 1996, *Numerical Methods for Engineers*, Prentice Hall.

Kreyszig, E., 2000, *Advanced Engineering Mathematics, 9th Edition*, John Wiley & Sons, Inc. New York.

Charles ReVelle, Elbert Earl Whitlatch, Jeff R. Wright, 2004, *Civil and Environmental Systems Engineering*, Prentice Hall.

Etter, D.M. and D.C. Kuncicky, 1999, *Introduction to MATLAB® for Engineers and Scientists*, Prentice Hall, New Jersey.

Mathews, J.H. and K.D. Fink, 2004, *Numerical Methods Using MATLAB®, 4th Edition*, Prentice Hall, New Jersey.

Palm III, W.J., 2005, *Introduction to MATLAB® 7 for Engineers*, McGraw-Hill, Boston.

**Laboratory:**

Weekly computer laboratory sessions will be held in the assigned Spencer Engineering Building (SEB) computer laboratories. During this time students will work on problems related to the assignments using the computer software MATLAB.

**Computing:**

Some assignments will require the use of MATLAB. This program is available in the SEB computer labs for students. Students are required to submit printed copies of their MATLAB work together with their submitted assignments.

**Units:**

SI units will be used in lectures and examinations

**Specific Learning Objectives:**

1. Introduction. At the end of this section, the student should be able to:
  - a. Understand and recognize when engineering problems need to be solved numerically.
  - b. Identify, classify and analyze different systems of equations, i.e., linear, non-linear equations, first or higher order, ordinary or partial differential equations.
  - c. Understand different methods available to formulate a solution to a system of equations.
  - d. Appreciate the types of problems that arise in civil and environmental engineering applications that require numerical analysis.
2. Linear and non-linear algebraic equations. At the end of this section, the student should be able to:
  - a. Apply numerical algorithms for the solution of linear equations including direct and iterative methods.
  - b. Use numerical solution techniques for solving single and systems of non-linear algebraic equations including Newton's method and various root finding.

3. Numerical integration and differentiation. At the end of this section, the student should be able to:
  - a. Apply numerical algorithms to solve ordinary and partial differential equations.
  - b. Apply finite difference methods for solving boundary value problems.
  - c. Understand the error bounds and convergence rates of numerical algorithms and perform error analysis.
4. Systems analysis. At the end of this section, the student should be able to:
  - a. Understand systems analysis, systems definitions and methods and tools for a systems approach.
  - b. Formulate problems using systems approach.
  - c. Optimize an engineering problem through systems analysis.
5. Computing skills. At the end of the course, the student should be able to:
  - a. Program numerical algorithms to solve equation sets.

Instructor may expand on material presented in the course as appropriate.

**General Learning Objectives:**

E=Evaluate, T=Teach, I=Introduce (*Beginner or Intermediate or Advanced Level*)

Problem Analysis	T	Team Work	T	Ethics and Equity	
Investigation		Communication	E	Economics and Project Management	
Design		Professionalism	I	Life Long Learning	I
Engineering Tools	E	Impact on Society			

**Evaluation:**

The final course mark will be determined as follows:

Weekly assignments and labs:	15%
Quizzes	20%
Group Project	15%
Final Exam	50%
	-----
Total	100%

Note:

- a) **Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.
- b) **Students must achieve a passing grade in the laboratory/tutorial/group project component to pass this course.** Students who do not satisfy this requirement will be assigned 48% or the aggregate mark, whichever is less.
- c) **Students who have failed this course previously must repeat all components of the course.** No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.
- d) **Should any of the quizzes conflict with a religious holiday that a student wishes to observe,** the student must inform the instructor of the conflict no later than two weeks before the scheduled test. (For further information on Accommodations for Religious Holidays see: [http://www.uwo.ca/univsec/handbook/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/handbook/appeals/accommodation_religious.pdf)).

### 1. Quizzes and Examinations:

Two 50 minutes quizzes will be scheduled during the semester. The quizzes will be held on February 11, 2016 and March 10, 2016. Both quizzes will be scheduled during the tutorial period on Thursdays. A 3 hour final examination will take place during the final examination period. **Programmable calculators are not permitted in the final exam and quizzes. Both quizzes and the final examination will be CLOSED BOOK: no programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted.** A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it! Part marks may not be awarded for some of the problems on the quizzes or final exam.

### 2. Weekly Assignments

Due date for all assignments will be as stated on the distributed assignments. Assignments will be available on the course OWL site. Assignments must be submitted for marking by 9:30 am on the due date, in locker 52 on the second floor (Spencer Engineering Building). Some assignments may include laboratory (computer) components. **Late assignments receive a grade of zero.** Extensions are to be negotiated with the course instructor, not the teaching assistants.

### 3. Group Project

Students will work in groups on a group project which forms a major deliverable in this course. Project selection will be done in early February. The project will involve the use of MATLAB and computational methods covered in class. Assessment will be based on a project report that is required to be submitted and a PowerPoint presentation of the project results. Further information on the group project will be provided to students in January.

### 4. Use of English

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

### **Plagiarism Checking:**

The University of Western Ontario uses software for plagiarism checking. Students may be required to submit their Laboratory Reports in electronic form to Turnitin.com for plagiarism checking.

### **Cheating:**

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:

[http://www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf)

### **Attendance:**

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**Accessibility:**

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

**Conduct:**

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <http://www.uwo.ca/univsec/board/code.pdf>

**Sickness and Other Problems:**

Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, please see:  
[http://www.uwo.ca/univsec/handbook/appeals/accommodation\\_medical.pdf](http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf)

**Notice:**

Students are responsible for regularly checking their email, course website (<https://owl.uwo.ca>) and notices posted outside the Civil and Environmental Engineering Department Office

**Consultation:**

Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

**Course Breakdown:**

Engineering Science = 30%; Mathematics = 70%.

The document "INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED" is part of this course outline.

**INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED**

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC ACCOMMODATION WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC ACCOMMODATION WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2015 UWO ACADEMIC CALENDAR).

**A. GENERAL REGULATIONS & PROCEDURES**

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or exam that is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097. Otherwise, you will report to your department office to request accommodation.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your Department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

**B. TERM TESTS**

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request accommodation. Otherwise, you will report to your department office to request accommodation.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

**C. FINAL EXAMINATIONS**

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a special examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

**N.B. It is the student's responsibility to check the date, time and location of the special examination.**

**D. LATE ASSIGNMENTS**

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
  - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
  - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

## E. SHORT ABSENCES

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

## F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms. Karen Murray in the Undergraduate Services Office, if you are in first year.

## G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctors notes will not be accepted; only the Student Medical Certificate will be accepted.**

**In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**For Other Extenuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

**Note:** Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

## H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

**Calendar References:** Check these regulations in your 2015 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

Absences Due to Illness: <http://www.westerncalendar.uwo.ca/2015/pg117.html>  
Academic Accommodations for Students with Disabilities: <http://www.westerncalendar.uwo.ca/2015/pg118.html>  
Academic Accommodations for Religious or Holy Days: <http://www.westerncalendar.uwo.ca/2015/pg118.html>  
Course Withdrawals: <http://www.westerncalendar.uwo.ca/2015/pg157.html>  
Examinations: <http://www.westerncalendar.uwo.ca/2015/pg129.html>  
Scheduling of Term Assignments: <http://www.westerncalendar.uwo.ca/2015/pg97.html>  
Scholastic Offences: <http://www.westerncalendar.uwo.ca/2015/pg113.html>  
Student Medical Certificate: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)  
Engineering Academic Regulations: <http://www.westerncalendar.uwo.ca/2015/pg1442.html>

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

### **Drop Deadlines:**

First term half course (i.e. "A" or "F"):	November 5, 2015
Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2015
Second term half or second term full course (i.e. "B" or "G"):	March 7, 2016

### **Contact Information:**

Undergraduate Services Office:	SEB 2097	Telephone: (519) 661-2130	Fax: (519) 661-3757
Dept. of Chemical and Biochemical Engineering & Green Process Engineering:	TEB 477	Telephone: (519) 661-2131	Fax: (519) 661-3498
Dept. of Civil and Environmental Engineering:	SEB 3005	Telephone: (519) 661-2139	Fax: (519) 661-3779
Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering:	TEB 279	Telephone: (519) 661-3758	Fax: (519) 850-2436
Dept. of Mechanical and Materials Engineering:	SEB 3002	Telephone: (519) 661-4422	Fax: (519) 661-3020