

**Western University
Faculty of Engineering
Department of Electrical and Computer Engineering**

SE 4455B: Cloud Computing

Course Outline 2016-17

Description: This course covers the fundamental engineering concepts behind cloud computing as well as technological issues in developing, deploying as well as utilizing cloud computing. We begin with a discussion of the basic concepts of resource virtualization as the underlying engineering solution that has enabled cloud computing. This is followed by application of resource virtualization to computing, networking, storage and applications. With this background, we will look at the architectural layers of cloud computing such as client, network, management and hardware as well as various deployment models (*-as-a-Service) and continue on to management and scheduling of cloud resources and end with an overview of various industrial solutions. Laboratory activities include configuration and programming on a combination of public/private provider platforms. Hands-on activities on utilizing various PaaS vendor platform and SaaS frameworks to configure, create, and extend software components will also be included.

Instructor: Prof. Jagath Samarabandu, P.Eng.
TEB 351, 519-661-2111 ext. 80058, jagath@uwo.ca
Consultation hours: Fridays 9:30-11:30am (drop in) or by appointment.

Academic Calendar Copy: The course concentrates on the fundamental elements of cloud computing such as resource virtualization and distributed systems including the main concepts of cloud infrastructures. Laboratory activities will allow, students to be exposed to fundamental technologies used by cloud computing such as virtual machines, virtual machine monitors, resource allocations, etc.

Contact Hours: 3 lecture hours, 2 laboratory hours, 0.5 course.

Antirequisite: None.

Prerequisites: ECE 4436A/B, SE 3313A/B, SE 3314 A/B

Co-requisite: None.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 75%, Engineering Design 25%.

Required Textbook: Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Prentice Hall, ISBN-13: 978-0-13-338752-0.

Recommended References: Cloud Computing Theory and Practice, Dan C. Marinescu, Morgan Kaufmann Publishers, ISBN-13: 978-0-12-404627-6.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	2/3	Use of Engineering Tools	3/1	Impact on Society and the Environment	1/3
Problem Analysis		Individual and Team Work		Ethics and Equity	
Investigation	2/3	Communication Skills		Economics and Project Management	
Design		Professionalism		Life-Long Learning	2/3

Notation: x/y , where x is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Topics and Specific Learning Objectives

1. Introduction to Cloud Computing.

- At the end of this section, students will be able to:
- Understand the promise and opportunities of cloud computing along with its challenges.
- Describe the technological principles that have enabled cloud computing.
- Identify core features of cloud computing, such as, elasticity, multi-tenant, on-demand, ubiquitous access, usage metering, self-service, etc.

2. Introduction to Resource Virtualization.

At the end of this section, students will be able to:

- Describe the need, pros and cons of resource virtualization.
- Name the types of virtualization of computing and describe the hardware/software support required.
- Describe types of network virtualization and its applications in cloud computing.
- Describe the basic principles of virtualization of storage.

3. Cloud Computing Architecture and management.

At the end of this section, students will be able to:

- Describe cloud architecture layers (client, network, management, hardware) and their function.
- Describe cloud service models such as infrastructure, platform and software as a service (IaaS, PaaS, SaaS) and provide examples.
- Make a cost/benefit/risk analysis for a given case of IaaS, PaaS and SaaS.
- Classify and describe the type of Clouds (Public clouds, Private clouds, Hybrid or heterogeneous clouds, Community clouds).

4. Cloud Resource Management and Scheduling:

At the end of this section, students will be able to:

- a. Understand the policies and mechanisms for cloud resource management, and the resource allocation control theoretic approaches.
- b. Analyze cloud-based scheduling algorithms, such as the fair queuing, start-time fair queuing, and borrowed virtual time scheduling algorithms.

5. Industrial Cloud Platforms and New Applications Developments:

At the end of this section, students will be able to:

- a. Apply several different options for building enterprise cloud computing applications using the cloud computing solutions offered as Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) services in the market, such as Amazon Web Services, Google AppEngine, Microsoft Azure, Heroku, and RightScale.
- b. Detailing the development architecture of cloud-based applications ranging from scientific to engineering, gaming, and social networking domains.

Evaluation

Course Component	Weight
Laboratory	20%
Midterm Test	20%
Final Examination	60%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the laboratory. A final examination or laboratory mark < 50% will result in a final course grade of 48% or less.

Laboratory: 4-5 assignments each with variable marks based on the complexity of each lab.

Midterm Test: The midterm test will be held in class on March 1, 8:30am-10:30am.

Final Examination: This will be a closed book examination and will be take place during the regular examination period.

Late Submission Policy: 10% per day for two days. Submissions will not be accepted after two days.

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for 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.

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, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: 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 the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). 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, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Missed Midterm Examinations: If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their department within 24 hours of the missed test. The department will decide whether to allow the reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course 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 by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about 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 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

**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 if you are in first year) 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 2016 Western [Academic Calendar](#)).

A. GENERAL REGULATIONS & PROCEDURES

1. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
2. Bring your request for academic accommodation to the attention of the Chair of the department (or the Undergraduate Services office if you are in first year) prior to the scheduled time of the test or final examination or due date of the assignment. If you are unable to contact the relevant person, leave a message with the appropriate department (or Undergraduate Services office, if you are in first year). The addresses, telephone and fax numbers are given at the end of these instructions. Documentation must be provided as soon as possible.
3. 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 exam reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are unable to write a term test, inform your instructor and the Chair of your Department (or the Undergraduate Services Office if you are in first year) prior to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office and inform the Chair of the Department (or the Undergraduate Services Office if you are in first year).
2. Be prepared to provide supporting documentation to the Chair and the Undergraduate Services Office (see next page for information on documentation).
3. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair (or the Undergraduate Services Office if you are in first year) 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 (please spell your full name).
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.

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.

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 the counsellors in the Undergraduate Services Office if you are in first year.

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 if you are in first year). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence.**

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).

ACADEMIC CONCERNS

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).

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.

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 2016 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Absences Due to Illness](#) - page 117

[Academic Accommodations for Students with Disabilities](#) - page 118

[Academic Accommodations for Religious Holidays](#) - page 119

[Incomplete Standing](#) - page 104

[Scheduling of Term Assignments](#) - page 97

[Scholastic Offences](#) - page 113

[Special Examinations](#) - page 132

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, 2016

Full courses and full-year half courses (i.e. "E", "Y" or no suffix):

November 30, 2016

Second term half or second term full course (i.e. "B" or "G"):

March 7, 2017

Undergraduate Services Office:

SEB 2097 telephone: (519) 661-2130

fax: (519) 661-3757

Dept. of Chemical and Biochemical 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) 661-4122

fax: (519) 661-3020