

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

SE 4452 A: SOFTWARE TESTING & MAINTENANCE

Course Outline 2023-2024

Description: The course focuses on software testing, verification and validation, and maintenance issues. Topics include review/inspection, testing techniques, levels of testing (unit, integration, system, acceptance, regression, etc.), and testing tools (static and dynamic). Review of software tools/techniques to manage changes in software and to control the evolution of a software project.

Contact Hours: 3 lecture hours/week, 0.5 course.

Antirequisite: CS 4472A/B

Prerequisites: SE 3352A/B

Restrictions: Limited to students in 4th year of Software Engineering students and to 3rd-year Software and HBA students.

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: There is no required text. I will be working heavily with *Introduction to Software Testing* (Offutt and Ammann) but it is not required. Some other suggested readings will be provided on Owl.

General Learning Objectives (CEAB Graduate Attributes)

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

Topics and Specific Learning Outcomes	CEAB GA Indicators
<ul style="list-style-type: none"> • Introduction to Software Quality Management: Engineering & Assurance <u>At the end of this section, students will be able to:</u> <ul style="list-style-type: none"> - Identify and develop quality framework and model utilizing industrial best practice samples in terms of quality factors, criteria and objectives as applied to software systems - Identify and develop the stages of the quality management cycle for software systems (quality engineering and quality assurance) as applied for the business quality objectives. - Identify and utilize quality engineering principles and techniques to engineer quality factors as defined within the adopted quality model 	<p style="text-align: center;">IN1, ET1</p>
<ul style="list-style-type: none"> • Software quality control: Review/Inspection and Testing <u>At the end of this section, students will be able to:</u> <ul style="list-style-type: none"> - Identify and apply quality control approaches (review-based and test-based) adequate for the nature of the software artifacts (static and dynamic) produced in each software development stage. - Utilize software reviews/inspections as quality control processes for static based (written material) software artifacts, including synchronous and asynchronous approaches for <ul style="list-style-type: none"> ○ Peer Reviews ○ Walkthroughs ○ Technical Reviews/inspections - Identify and define the testing stages (unit, integration, system and acceptance) and the levels (functional, structural and system) adequate for the software artifacts produced in the corresponding development stage. 	<p style="text-align: center;">IN1, IN2, ET1, ET2</p>

<ul style="list-style-type: none"> • Level of Testing: Functional Testing & Structural Testing <p><u>At the end of this section, students will be able to:</u></p> <ul style="list-style-type: none"> - Understand the nature of the functional (Black Box) testing in relationship to the quality objectives as specified by the quality framework. - Apply the functional testing to the different stages of testing. - Design and implement functional testing suits using equivalence partitioning, boundary value analysis and decision tables. - Understand the nature of the structural (White Box) testing in relationship to the quality objectives as the quality framework. - Define and design the structural testing applicable to the unit and integration testing stages. - Understand and utilized the concepts of complexity, code coverage and completeness analysis as applied for unit testing. - Design and implement structural test suits using <ul style="list-style-type: none"> o Flow Graph Testing <ul style="list-style-type: none"> i. Decision-to Decision Paths ii. Test Coverage Metrics iii. Basis Path Testing o Data Flow Testing <ul style="list-style-type: none"> i. Define/use Testing ii. Slice Based Testing 	IN1, IN2, IN3, ET1, ET2, ET3
<ul style="list-style-type: none"> • Stages of Testing: Unit, Integration, System & User Acceptance <p><u>At the end of this section, students will be able to:</u></p> <ul style="list-style-type: none"> - Understand the nature of the unit testing stage in relationship to the entire software architecture and the required quality objectives. - Apply the unit testing to the individual modules of the architecture confirms to the quality requirements. - Design and implement unit testing settings, environment and supporting functional and structural using software tools. - Understand the nature of the integration testing stage in relationship to the entire software architecture and the required quality objectives. - Apply the integration testing for the software system at the architecture confirms to the quality requirements using <ul style="list-style-type: none"> o Based on Functional Decomposition (<i>Functional Dependency</i>) <ul style="list-style-type: none"> i. Big Bang ii. Top-Dow iii. Bottom-Up iv. Sandwich o Based on Call Graph (<i>Interaction Dependency</i>) <ul style="list-style-type: none"> i. Pair-wise ii. Neighborhood o Based on Paths (<i>Flow Dependency</i>) <ul style="list-style-type: none"> i. Module-Message Paths - Design and implement unit testing settings, environment and supporting functional and structural using software tools. 	IN1, IN2, IN3, ET1, ET2, ET3

<ul style="list-style-type: none"> - Understand the nature of the system testing stage in relationship to the entire software architecture and the required quality objectives. - Identify the appropriate testing approaches and techniques for each quality factor to the system level of software that confirms to the quality requirements for <ul style="list-style-type: none"> o Performance Testing o Security Testing o Load Testing o Stress Testing o Scalability Testing o Robustness Testing - Understand the nature of the acceptance testing in relationship to the entire software user-centric and business-centric quality objectives. 	
<ul style="list-style-type: none"> • Traditional Software Change and Regression Testing <u>At the end of this section, students will be able to:</u> <ul style="list-style-type: none"> - Understand the importance and the management of software changes due to fixing a defect, adding functionality, etc. in all related software artifacts in a way they do not affect functionalities/features/behavior that should not be affected. - Understand the importance of applying regression testing and its relationship with unit, integration and system testing. - Apply regression testing using Selecting Modification Traversing Tests, and Dynamic Slice 	<p>I1, I3, ET1, ET2, ET3</p>
<ul style="list-style-type: none"> • Continuous Software Evolution with Continuous Integration and Testing <u>At the end of this section, students will be able to:</u> <ul style="list-style-type: none"> - Understand the evolution of the new trend of continuous and tool-based automated software production and evolution with focus on continuous, development, integration, delivery, deployment and monitoring - Understand the nature and principles of continuous testing in relationship to the entire modern software development with focus on DevOps approach. 	<p>I1, ET1, ET2</p>

Evaluation

Course Component	Weight
Homework Assignments	30%
Midterm Test	15%
Final Examination	55%

Homework Assignments: Homework assignments will be assigned on Owl throughout the term. Homework assignments have different weights. Homework assignments may be programming-based. All assignments should be submitted as soft copies to the course website at Sakai/OWL. Hard copies are not required. All assignments will be checked for plagiarism.

Midterm Test: The midterm will be held in class during lecture hours. During

exams/tests/quizzes all electronic devices must be powered down and stored out of reach. The only exception is a simple scientific non-programmable, which is permitted. Other devices capable of substituting for a simple calculator (e.g. a phone, laptop, iPad), are not permitted.

Final Examination: The final examination will be take place during the regular examination period.

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.

Missed Midterm Examinations: We will not have make-up midterms. If you miss the midterm for a justified reason, the weight will be shifted to the final examination.

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.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western [is committed to reducing incidents of gender-based and sexual violence](#) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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 relief 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 relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
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/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/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 midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/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 report your absence using the [Academic Consideration Request Form](#) and 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, headache, 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 submit an "[Application for a Special Exam](#)" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: 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 submit the [Academic Consideration Request Form](#) and 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 Assistant Dean, First Year Studies, 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, Undergraduate Studies. 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, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory 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 are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

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 doctor's 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 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_13_5

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=#Page_78

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

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.

<u>Add Deadlines:</u>	First term half course (i.e. “A” or “F”)	September 15, 2023
	Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 15, 2023
	Second term half course (i.e. “B” or “G”)	January 16, 2024

<u>Drop Deadlines:</u>	First term half course without penalty (i.e. “A” or “F”)	November 13, 2023
	Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	November 30, 2023
	Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2024

Contact Information:

Undergraduate Services Office:	SEB 2097	Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering:	TEB 477	Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005	Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279	Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410	Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering:	SEB 3002	Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca