Western University Faculty of Engineering
Department of Electrical and Computer Engineering

SE 4452A - SOFTWARE TESTING & MAINTENANCE
Course Outline Fall/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.

Instructor:
Dr. Yili (Kelly) Tang, P.Eng. Email: ytang564@uwo.ca;

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

Lectures Location and Time:

September 6th, 2024 – December 6th, 2024
Tues: 12:30 pm – 2:30 pm
Fri: 3:30 pm – 4:30 pm

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%.

Requited Textbook: There is no required text. The lecture notes will be mainly based on *Introduction to Software Testing* (Offutt and Ammann) but it is not required. Additional optional textbook is *Software Evolution and Maintenance: A Practitioner's Approach* (Priyadarshi Tripathy, Kshirasagar Naik) and *Software Testing: A Craftsman's Approach, Fourth Edition* (Paul C. Jorgensen). 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
• **Introduction to Software Quality Management: Engineering & Assurance** At the end of this section, students will be able to: – 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	**IN1,** ET1

• **Software quality control: Review/Inspection and Testing**
 	
At the end of this section, students will be able to:
 	
– 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
 	
    o Peer Reviews
    o Walkthroughs
    o 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.
	IN1, **IN2**, ET1, **ET2**

• **Level of Testing: Functional Testing & Structural Testing**
 	
 At the end of this section, students will be able to:
 – 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
      o Flow Graph Testing
         i. Decision-to Decision Paths
         ii. Test Coverage Metrics
         iii. Basis Path Testing
      o Data Flow Testing
         i. Define/use Testing
         ii. Slice Based Testing
	IN1,
	 IN2,
	 IN3,
	 ET1,
	 ET2,
	 ET3

• **Stages of Testing: Unit, Integration, System & User Acceptance**
 	
At the end of this section, students will be able to:
– 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
   o Based on Functional Decomposition (*Functional Dependency*)
      i. Big Bang
      ii. Top-Dow
      iii. Bottom-Up
      iv. Sandwich
   o Based on Call Graph (*Interaction Dependency*)
      i. Pair-wise
      ii. Neighborhood
   o Based on Paths (*Flow Dependency*)
      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**

– 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
   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.	

• **Traditional Software Change and Regression Testing** At the end of this section, students will be able to: – 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	**IN1, IN3,** ET1, **ET2, ET3**
• **Continuous Software Evolution with Continuous Integration and Testing** At the end of this section, students will be able to: – 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.	**IN1,** ET1, **ET2**

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.

LATE SUBMISSION POLICY:
Advise the instructor if you are having problems completing the assignment on time prior to the due date of the assignment and be prepared to submit an Academic Consideration Request and provide documentation if requested by the instructor at:
https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

If you are granted an extension, establish a due date with the instructor. The approval of the Chair of your Department is not required if assignments are completed prior to the last day of classes. 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.

ATTENDANCE: Attendance is mandatory for all lectures.

ABSENCE FROM MANDATORY COURSE COMMITMENTS: Students must familiarize themselves with the Policy on **Academic Consideration for Absences:** https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html

I. **Missed/Late Accommodation Policy**
1. The Academic Consideration Request Form is available through the STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible. Requests for academic consideration must include the following components:
   a. Indication of the course(s) and assessment(s) affected by the request
   b. Medical note, and
   c. Additional supporting documentation as relevant
3. Requests for academic consideration without a medical note or other supporting documentation may be accepted once per term, per course.
4. Undocumented absences cannot be used for examinations scheduled by the Office of the Registrar during official examination periods (including take-home final exams and December mid-year exams for full courses) and practical laboratory and performance tests typically scheduled in the last week of the term. Undocumented absences also cannot be used for the "designated assessment" in each course. When flexibility in assessment exists and is clearly stated on the course outline, both undocumented absences and academic consideration requests with documentation may be denied.
5. Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence.

II. **Exam Accommodation**
1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
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 the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

III. **LATE ASSIGNMENTS**
IV. **Medical Accommodation**
1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Requests for academic consideration must include the following components:
   a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)

b. Medical note. Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence.
c. Indication of the course(s) and assessment(s) affected by the request
d. Supporting documentation as relevant

3. Requests without supporting documentation are limited to one per term per course.
4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

   Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Registration.

6. **An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade** (e.g., "8 of 10 quizzes"). Assessment flexibility must be indicated on the course outline.
7. **An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submission timeframe** (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

V.   Religious Accommodation
When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

VI.   Academic Integrity
In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

VII.   Academic Offences
Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, 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

VIII. Faculty of Engineering AI Policy

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.
GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

IX. Use of English Policy

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 except for 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.

X. Accessibility

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

XI. Inclusivity, Diversity, and Respect

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

XII. Health and Well-Being

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.

- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - 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.

Important Contacts

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Electrical and Computer Engineering	TEB 279	519-661-2111 x86264	eceugrad@uwo.ca
Office of the Registrar/Student Central	WSSB 1120	519-661-2100	

Important Links

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES
- ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS
- UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES
- IMPORTANT DATES AND DEADLINES
- ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS
- ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS
- SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS
- STUDENT FORMS
- OFFICE OF THE REGISTRAR
- RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)
- ACADEMIC APPEALS
- STUDENT ABSENCE PORTAL