Toronto Metropolitan University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

Course Outline (W2025)

COE891: Software Testing and Quality Assurance

Instructor(s)	Dr. Reza Samavi [Coordinator] Office: ENG457 Phone: (416) 979-5000 x 554903 Email: samavi@torontomu.ca Office Hours: TBA
Calendar Description	Introduces students to various techniques to verify and validate software and software-hardware co-design systems with an emphasis on the design and implementation of system-level software, System-On-Chip systems, Electronic-Design-Automation tool flows, and embedded systems.
Prerequisites	COE 692
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. Introduction to Software Testing, Second Edition, Paul Ammann and Jeff Offutt, Cambridge University Press, 2017. 2. Selected chapters of the reference texts and several articles on software testing topic as indicated in the course content.
Reference Text(s):	1. Test Driven: Practical TDD and Acceptance TDD for Java Developers, Lasse Koskela, Manning Publications, 2007. 2. xUnit Test Patterns: Refactoring Test Code, Gerard Meszaros, 1st Edition, Addison-Wesley Signature Series (Fowler), 2007 3. Software Testing, a Craftsman Approach, Fourth Edition, Paul C Jorgensen, 2014. 4. Software Testing and Analysis: Process, Principles, and Techniques, Mario Pezze and Michal Young, 2007. 5. The Calculus of Computation: Decision Procedures with Applications to Verification, Bradley, Aaron R., and Manna, Zohar, Springer Berlin Heidelberg, 2007.
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. Develop a deep understanding of systematic methods to debug complex object oriented programs. (**1c**) 2. Be able to develop, maintain, document and execute test cases. (**4a**) 3. Understand and implement at different testing levels including unit, integration, system and operational acceptance levels. (**5a**) 4. Be able to develop documentation for testing exercises and communicate findings with developers. (**6a**), (**7c**) 5. Consider environmental implications of software programs when testing for operational acceptance. (**9b**) 6. Plan for software testing projects with continuous integration and test-driven development. (**11b**)

NOTE:*Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*

Course Organization

3.0 hours of lecture per week for 13 weeks
2.0 hours of lab per week for 12 weeks
0.0 hours of tutorial per week for 12 weeks

Teaching Assistants

TBA

Course Evaluation

Theory	
Mid-term Examination	25 %
Final Examination	40 %
Laboratory	
Lab assignments	25 %
Project	10 %
TOTAL:	100 %

Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both **"Theory and Laboratory"** components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section above for details on the Theory and Laboratory components (if applicable).

Examinations

Midterm examination in Week 7, 1.5-2 hours, closed book (covers Weeks 1-6).
Final examination, during exam period, 2-3 hours, closed book (covers Weeks 1-13).

Other Evaluation Information

In order to achieve a passing grade in this course, the student must achieve an average of at least 50% in both theoretical and laboratory components.

Teaching Methods

- Notes/slides from the class lectures will be posted on D2L.
- Laptops/computer systems are mandatory requirement for the course lectures and labs.
- Audio/video recordings of the lecture delivery will not be posted on D2L. Individual students may record the lectures at their own discretion and the professor is not responsible for such recordings.

Other Information

All the labs have to be performed individually by each student. Each lab has its own weight as specified in the lab instructions. Submissions that are substantially similar will be considered plagiarized. Projects requires to be completed in a team of students from the same lab section. Any late submission of the lab deliverable will be deducted 10% per day up to 8 days, whereby the lab will not be accepted.

Course Content

Week	Hours	Chapters / Section	Topic, description
1	3	AO: Ch. 1, Ch. 2.1	Introduction to Software Testing and and Quality Assurance; Course administration; Goals of testing software; Key concepts of software testing;
2	3	AO: Ch.2, Ch. 3, and Ch. 4	Software Model Driven Test Design (MDTD), Agile SDLC and Agile testing methodologies, Data-Driven Tests (DDT), Test automation: JUnit test framework, Java path finder, and other automated test frameworks;
3	3	AO:Ch. 5, Ch. 7.1	Criteria and coverage; Graph coverage overview; Infeasibility and subsumption;
4	3	AO: Ch. 6	Input Space Partitioning (ISP); Input Domain Modeling: Interface based, functionality based;
5	3	AO: Ch. 7.2, Ch. 7.3	Graph coverage criteria; Introduction to graph control flow; Data flow criteria; Graph coverage for source code;
6	3	AO: Ch. 7.4, 7.5	Graph coverage for specifications; Graph coverage for design; Graph coverage for use cases; Midterm exam review;
7	3	AO: Ch. 7.6. Ch. 8.1	Techniques for improving test design; Semantic logic coverage criteria;
8	3	AO: Ch. 8.1-8.3	Test automation tools for logical coverage;Structural logic coverage of programs;
9	3	AO: Ch. 8.4-8.7 and posted material	Specification-based logic coverage; Logic coverage of finite state machines (FSM); Hardware(RTL,System Verilog)/software co-design and verification;
10	3	AO: Ch. 9, Ch. 13	Syntax based Testing: Program-Based Mutation, Integration Mutation
11	3	AO: Ch. 10, 11, and 14	Specification-Based Mutation; Continuous integration (regression testing) and containerized testing strategy; Managing test processes; Designing test plans; Designing Effective Test Oracles;

12	3	posted material	Software verification; Principles of verifying and validating of system-level software, System-On-Chip, and embedded systems;
13	3	posted material	Research topics in software testing and quality assurance; Software testing and artificial intelligence; Final exam review;

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
2-3	Lab 1	JUnit. Review of Automated Testing Advanced Automated Testing in JUnit: Suit Testing and testing Using TestNG, Parametrized tests and theories in JUnit Project activities: Team forming
4-5	Lab 2	Coverage-based Test Design, Code Coverage tools (OpenClover), Input Domain Model and derive Input Space Partitioning (ISP) test inputs; Project activities: Topic selection, Self-reading and practice: Agile testing methodologies using Test Case Management: e.g., TestLink Open source, X-Ray test management, TestRail Test Case Management
6-7	Lab 3	Web application testing with ISP approach using TestNG and Selenium. (week 6) Project activities: Project proposal development including, topic justification, open source application, and working on proposed test plan (week 7)
8-9	Lab 4	Graph coverage prime path and complete path; Apply structural graph coverage and data flow coverage to source code; Apply graph coverage to test various parts of the software design (weeks 8 and 9). Project activities: Test plan submission and project checkpoint (week 9)
10	Lab 5	Logic coverage; Automatic Generation of High-Coverage Tests for Complex Systems Programs. Project activities: Project Q&A and review
11	Lab 6	Syntax based testing, Mutation Testing Project activities: Project Q&A and review

12-13	Project	Project activities: Project Q&A and review (week 12) Project: Final Project submission (week 13)

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on the Senate website

Refer to the Departmental FAQ page for furhter information on common questions.

Important Resources Available at Toronto Metropolitan University

- The Library provides research workshops and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the Library's virtual research help service to speak with a librarian.
- Student Life and Learning Support offers group-based and individual help with writing, math, study skills, and transition support, as well as resources and checklists to support students as online learners.
- You can submit an Academic Consideration Request when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the Senate website and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

  For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate Policy 167: Academic Consideration.
- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The Remote Learning Guide for students includes guides to completing quizzes or exams in D2L Brightspace, with or without Respondus LockDown Browser and Monitor, using D2L Brightspace, joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for Faculty and students.

Accessibility

- Similar to an accessibility statement, use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about Academic Accommodation Support.
- Learn how to register with AAS.

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about Academic Accommodations versus Academic Consideration and how to access each.

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:**24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:**24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via My SSP app or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the Toronto Metropolitan University Mental Health and Wellbeing website.