

1. Calendar Information

SENG521 Software Reliability and Quality

The principles, processes, and applications of software reliability and software quality assurance.

Course Hours: H(3-2)

Calendar Reference:

<http://www.ucalgary.ca/pubs/calendar/current/software-engineering.html#10263>

SENG521 is a step by step description of software quality and software reliability engineering process. It includes introduction to software quality, prediction and measurement of software size and cost, software reliability engineering process, defining necessary reliability, developing operational profiles, decision making based on the test results, techniques to improve and predict software reliability, application of quality concept to agile and incremental software development processes. The focus is on the reliability of object-oriented software systems.

A workshop (project) is designed to reinforce the presented material. In the workshop, the students will actually go through the estimation and evaluation of quality of a realistic software project.

2. Learning Outcomes

The following questions will be answered throughout the course:

- What is software quality? What affects software quality?
- What is software reliability engineering (SRE)?
- Why SRE is important? How does it affect software quality?
- What are the main factors that affect the reliability of software?
- How can one determine what the size of the software will be?
- How can one determine how much it will cost to develop the software?
- How can one determine how often will the software fail?
- How can one determine the current quality of the software under development?
- How can one determine whether the software is reliable enough to be released?
- Can SRE methodology be applied to the current ways of software development: like object-oriented, component-based and agile development?
- What are challenges and difficulties of applying SRE?

3. Timetable

Section	Days of the Week	Start Time	Duration (Minutes)	Location
L01	MWF	11:00	50	ST 064
B01	M	16:00	110	ICT 217

4. Course Instructors

Lecturers

Section	Name	Phone	Office	Email
L01,B01	Dr. Behrouz Far	210-5411	ICT 543	far@ucalgary.ca

Tutorial Instructors

n/a

Laboratory Instructors

Section	Name	Phone	Office	Email
B01	TBA (Teaching Assistant)	TBA	TBA	TBA

5. Examinations

The following examinations will be held in this course:

- Midterm exam: The midterm examination will be scheduled at a time near the end of October or beginning of November. The exact time and location will be announced in class and on the course's Web page well in advance.
- Final exam: The final examination will be scheduled by the Registrar's Office at a time in the two-week period following the end of classes in December.

Note: The timetable for Registrar Scheduled exams can be found at the University's Enrolment Services website, <http://www.ucalgary.ca/registrar/>.

6. Use of Calculators in Examinations

Scientific (with logarithm and exponentials calculations capability) calculators without text display features may be used during examinations and quizzes.

7. Final Grade Determination

The final grade in this course will be based on the following components:

Assignments (Laboratory Reports)	40	%
Midterm Examination	20	%
Final Examination	40	%
TOTAL	100	%

Notes:

- a) It is necessary to earn a passing grade of at least 50% on the final exam in order to pass the course. It is also necessary to submit all Laboratory Reports to pass the course.

- b) Conversion from a score out of 100 to a letter grade will be done using a scale determined after the final examination has been marked. This allows the creation of a scale appropriate to the relative difficulty or easiness of the term work and the final exam.

8. Textbook

The course slides and hand outs are the major source of information. All the slides and hand outs are downloadable from the course Web page and/or Blackboard. For those with limited access to the internet, a software archive containing all the documents will be distributed on demand. The following textbooks are recommended for (SENG 521) as reading supplements.

Title	Metrics and Models in Software Quality Engineering (2nd ed.) (528 pages)
Author(s)	Stephen H. Kan
Edition, Year	ISBN 0-201-72915-6 (2002)
Publisher	Addison-Wesley

Title	Software Reliability Engineering: More Reliable Software Faster and Cheaper (608p.)
Author(s)	John D. Musa
Edition, Year	ISBN 1-4184-9387-2 (2004)
Publisher	Authorhouse Publishers

Title	Handbook of Software Reliability Engineering (850p.)
Author(s)	M.R. Liu (Edt.)
Edition, Year	ISBN 0-07-039400-8 (1996)
Publisher	IEEE Computer Society Press

9. Course Policies

All Schulich School of Engineering students and instructors have a responsibility to familiarize themselves with the policies described in the Schulich School of Engineering Advising Syllabus available at:

<http://schulich.ucalgary.ca/undergraduate/advising>

10. Additional Course Information

Course email list:

All students are automatically subscribed via blackboard. An email list will be available there.

Purpose of course:

To familiarize students with the applied software reliability and quality.

Approach to course:

Students will learn through a combination of lectures, project work, assignments and project reviews.

Educational aim:

During the course the students are grouped into teams composed of 2-3 members. Each team is asked to design a moderately realistic software project. A list of projects that the students can select among them will be posted on the course web page. The laboratories reports (design and test documents) of various phases of the assigned project should be handed in for check and marking. The reports are reviewed and a group discussion will be held in the lab hours. Unlike many undergraduate courses, and similar to what is actually performed in industrial practice, the laboratories hours are for group discussion and review of the projects. Additional discussion and review hours can be arranged by the students, TA(s) and the instructor.

Detailed contents:

1st week: Overview of software reliability and quality (2 sessions)

- Introducing the course.
- What is software reliability?
- What factors affect software quality?
- The software quality triangle.
- What is software reliability engineering?
- Introducing software reliability engineering process.

2nd week: Prediction and measurement of software size (3 sessions)

- Software size
- Software Size: Length (code, specification, design)
- Software Size: Reuse
- Software Size: Functionality (function point, feature point, object point, use-case point)

3rd week: Prediction and measurement of software cost and effort (4 sessions)

- Software cost model
- COCOMO and COCOMO II
- Constraint model
- Software Lifecycle Management (SLIM)
- Cost models: advantages and drawbacks

4th week: Measuring external product attributes: quality (3 sessions)

- Software quality
- Software quality models: Boehm's model, McCall's model, ISO 9126 model, etc.

- Basic software quality metrics
- Quality management models
- Measuring customer satisfaction

5th week: Review of software Reliability Models (3 sessions)

- Basic Features of the Software Reliability Models.
- Single Failure Model.
- Reliability Growth Model.
- Exponential Failure Class Models.
- Weibull and Gamma Failure Class Models.
- Infinite Failure Category Models.
- Bayesian Models.
- Early Life-Cycle Prediction Models.

6th week: Defining necessary reliability & Developing operational profiles (4 sessions)

- Introducing failure severity class and failure intensity objective concepts.
- Steps in defining necessary reliability.
- Computing failure intensity objective for developed software.
- Representation of operational profile.
- Procedure to define operational profile.
- Create functions/operations list.
- Determine occurrence rate of individual operations.
- Determine occurrence probabilities.

7th week: Strategies to meet reliability objective (3 sessions)

- Fault prevention strategy: software product and process improvement using ISO 9000-3.
- Introducing fault tolerance concepts and definitions. Coincident, correlated and dependent faults.
- Fault tolerance phases.
- Recovery block mechanism and Acceptance testing.
- Exception handling, expected and unexpected events.
- Construction of robust software systems.
- Defensive programming, dual software technique.
- Adjudication by voting.
- Recovery blocks, N-version programming, Consensus recovery block, Acceptance voting, N self-checking programming.
- Serial and parallel system reliability.

8th week: Preparing for test (3 sessions)

- Direct and indirect input variables.
- Operation, load and regression test.
- What is a test case?
- How to manage test cases?
- Test procedure.
- Equivalence classes and boundary conditions.
- How to develop test cases?
- How to allocate test time among system components based on test type (feature test, regression test, load test) and operation modes?

- In what order the test should be carried on?
- How to write a test suite?
- How many test cases and runs should be invoked?
- What deviation could be discovered?
- How to document the execution results?

9th week: Software reliability tools (2 sessions)

- Introducing SRE simulation and reliability growth tools such as: SMERFS, SRMP, SoftRel, CASRE.
- Case study using CASRE.

10th week: Applying failure data to guide decisions (3 sessions)

- Guiding decisions for certification test.
- Guiding decisions for reliability growth test.
- Handling program evolution, unreported failures and variations of operational profiles.

11th week: Deploying software reliability and quality (3 sessions)

- Software Quality System (SQS); Software Quality Assurance (SQA) and Software Reliability Engineering (SRE)
- Quality, test and data plans
- Defect reporting procedure

12th week: Variation of development processes (3 sessions)

- Software Reliability Engineering (SRE) vs. clean-room development
- SRE in incremental, spiral and agile developments

The SENG 521 course home page contains links to up-to-date course information, problem assignments, announcements, as well as laboratory and examination scheduling. The SENG 521 course home page is available through the B.H. Far's home page at the URL:

<http://www.enel.ucalgary.ca/People/Far/Lectures/SENG521/>

Watch the SENG521 course homepage regularly for updates, if any, to this document.

Template revised on 14 July 2011 (RWB)