

# CO 342 Introduction to Graph Theory (online) - Fall 2020

## Course Outline

Connectivity:  $k$ -connectivity, Menger's theorem and related results, minors and subdivisions, 2-connected and 3-connected graphs

Planar graphs: planar drawings, Kuratowski's Theorem

Matchings: Hall's theorem, vertex and edge covers, Tutte's theorem, matching algorithms, stable matching,  $f$ -factors

Vector spaces associated with graphs: flow space, bases, codes

## Instructor

P.E. Haxell, [pehaxell@uwaterloo.ca](mailto:pehaxell@uwaterloo.ca) (if you send e-mail, please put CO342 in the subject line).

## 1 How to take this course

The course activities each week (Week  $n$ , Monday to Sunday) are as follows.

- Prepare for and attend your Supervision on Tuesday, 9am or noon. Write the Supervision Quiz at the end of your supervision. (see **Supervisions** section.) Note: There are two exceptions to the schedule for Supervisions: the first supervision (which will be for practice only) will take place on Thursday Sept. 10, and the last supervision will be on Monday December 7.
- View the three Lectures for Week  $n$  (available by Friday of Week  $n - 1$ ).
- Submit the Week  $n$  LEARN Quiz by Sunday of Week  $n$  (11:30pm).
- Work on Assignment  $n - 1$  (available by Friday of Week  $n - 1$ ). Submit Assignment  $n - 1$  by Sunday of Week  $n$  (11:30pm).

## 2 Assessment

Assessment will be continuous throughout the term. Thus it is essential that you keep up with the material each week.

**LEARN Quizzes (LQ):** 12 LEARN quizzes, one each week. These are timed assessments (24+1 minutes), to test your basic understanding of the lecture material. Find  $LQ_n$  on LEARN under Lectures, Week  $n$ . It must be submitted by 11:30pm on Sunday of Week  $n$ , starting in Week 1. The lowest two LQ grades out of  $LQ_1$ - $LQ_{11}$  will be dropped. The  $LQ_{12}$  grade will not be dropped. The LQ's play the role of brief in-class quizzes on recently introduced concepts. You may not consult any sources or confer with anyone while writing the LQ's.

**Supervisions:** 12 graded Supervisions, one each week on Tuesday, at 9am or noon, depending on your Supervision group meeting time. (The Supervision in Week 1 is for practice only and will not be graded.) Each Supervision is marked out of 4, consisting of 1 for participation, plus a mark out of 3 for quality of solutions you give. See the **Supervisions** section for details on supervisions. The lowest two Supervision grades out of Supervisions 1-11 will be dropped. The Supervision 12 grade will not be dropped.

**Supervision Quizzes (SQ):** 10 Supervision Quizzes, which you will write each Tuesday at the end of your supervision meeting, and submit immediately via Crowdmark. (The SQ in Week 1 is for practice only and will not be graded.) These are timed assessments (20 minutes). Each SQ is marked out of 5. See the **Supervisions** section for more details on SQ. The lowest two SQ grades will be dropped. The SQ's play the role of test questions. You may not consult any sources or confer with anyone while writing the SQ's.

**Assignments:** 10 assignments, one each week. They must be submitted by 11:30pm on Sundays, starting with Assignment 1 due Sunday September 20. Each assignment consists of two questions, each marked out of 5. The lowest two assignment grades will be dropped. Assignments will be marked on clarity of presentation as well as accuracy. Poorly presented assignments may be returned unmarked. Late assignments will not be marked. You may consult the course material and discuss ideas with other students, but your solutions must be written independently. Taking written notes during discussions with others constitutes cheating. Looking up solutions in online resources or elsewhere is also considered cheating.

**Term Tests:** 2 one-hour term tests, on Thursday October 22 and Thursday December 3. These tests will be video-proctored by CO342 course personnel.

**Final Grade Calculation:** The final grade calculation will be as follows.

LQ 10%, Supervisions 15%, SQ 15%, Assignments 20%, tests each 20%.

**Missed Assessments:** The only reasons for missing an assessment that will be considered valid are (a) serious illness or (b) technology failure. If you miss an assessment for valid reasons, you must send an email to TA Evelyne Smith-Roberge (address below) with a declaration of the valid reason. In the case of serious illness, the usual requirements for documentation apply. Work(\*) missed during the term will be made up on the basis of individual plans after the term ends, during the Final Exam period. These plans may include oral exams and/or individual comprehensive projects. (\*)NOTE: since the lowest two marks in each of the categories LQ, SQ, Assignments and Supervisions will be dropped, the first two assessments in these categories that are missed for valid reasons will not be made up.

**Re-mark requests:** For queries regarding assignment or SQ marking, write your specific query in an email to TA Evelyne Smith-Roberge (address below) who will forward it to the appropriate marker for reply.

### 3 Supervisions

Supervisions are weekly online face-to-face meetings of a small group of students plus one TA or instructor (the “supervisor”). You should receive a Zoom invitation to your supervision meeting by noon on Mondays: if not then please email the instructor (pehaxell@uwaterloo.ca). The supervision in Week 1 (Thursday September 10) will be for practice only, and will not be graded.

In the first part of each supervision, the supervisor will invite solutions to questions on the course material, of the following types:

- **Open** questions, on Lecture material from the previous week. Any student may volunteer to answer Open questions.
- Solution to the **SQ** from the previous week.
- Solutions to the **assignment** questions submitted 9 days previously.
- Explanations of the **LQ** questions from the previous week.

#### **Notes on assessment:**

- The supervisor may call on a specific student or students to explain their solution to the SQ, Assignment, or LQ questions. You would be asked to explain your solution only if it was correct.
- You will not be penalized for an incorrect solution to any question that you volunteer to answer (but keep in mind that the supervisor needs to share out the opportunities to answer questions). Please use the **raise hand** function when volunteering to answer questions.
- The grades for each supervision will be out of 4 points. One point is for participation, for making any positive contribution during the supervision (answering a question even partially, asking a question about the course material, making a useful comment etc.). The remaining 3

points evaluate solutions: one complete and correct solution earns 3 points; one good solution that maybe misses some details earns 2 points; one idea that leads in some positive direction earns 1 point. Your grade will be determined by the best solution you give.

The second part of the supervision will be a general discussion, in which students will be invited to ask questions about the course material, ask for help with the current assignment, etc.

**Preparing for your supervision:** Have at hand your solutions to the SQ and the assignment that will be discussed. Review the Lecture material and LQ from the previous week. Prepare any questions or comments you might have about the course material or the assignment you are currently working on.

**Supervision Quiz:** The SQ is a timed (20 minute) test question requiring a written solution, on the course material from the previous week. At the end of your supervision, the supervisor will tell you the SQ question. Write your solution to the question and submit via the SQ Crowdmark link. Your supervisor will tell you the precise time your solution must be submitted. (If any group members are absent due to technical problems, your supervisor will also email the SQ question and the submission time to all group members, so that absent members can still write the SQ.)

## 4 Additional notes

**Discussion Forum:** Piazza will be used for the course discussion board. Questions on Piazza will be answered by a TA or instructor for one hour per day, Monday to Friday. Note: postings from students can be made anonymous to other students, but will be identifiable to instructor and TA's.

### Teaching Assistants:

For queries regarding Crowdmark please contact TA Soffia Arnadottir ([soffia.arnadottir@uwaterloo.ca](mailto:soffia.arnadottir@uwaterloo.ca))

For queries regarding assignment or SQ marking, or to record missed assessments, please contact TA Evelyne Smith-Roberge ([evelyne.smith-roberge@uwaterloo.ca](mailto:evelyne.smith-roberge@uwaterloo.ca))

Matthew Kroeker ([mekroeker@uwaterloo.ca](mailto:mekroeker@uwaterloo.ca))

Sabrina Lato ([smlato@uwaterloo.ca](mailto:smlato@uwaterloo.ca))

Shayla Redlin ([shayla.redlin@uwaterloo.ca](mailto:shayla.redlin@uwaterloo.ca))

**Slides:** Under Slides on LEARN you will find a snapshot of the “full whiteboard” at the end of each of the video clips that make up the Lectures.

**Writing proofs:** In written solutions (SQ, assignment, and term tests), results from the course and from Math239 may be used without proof. However you must **state clearly** what result you are applying: if it has a name then you can refer to it by name (e.g. “by the Handshake Lemma”), otherwise state the result itself (e.g. “from Math239, every connected graph has a spanning tree”). Theorems from e.g. other CO courses you may have taken cannot be used without proof.

**Course Notes:** *Graph Theory: Course Notes for CO 342* are for reference only, and are available under “Course Information”. ALL assessments will be based on the material given in Lectures, which may sometimes differ slightly from the material in the notes.

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## **University Policies:**

Links to the Policies and Guidelines referred to below can be found on the University of Waterloo website.

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

**Discipline:** A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline. For typical penalties check Guidelines for the Assessment of Penalties.

**Appeals:** A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals.

**Note for students with disabilities:** AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.