



# Syllabus

Description, staff, grading, and every course policy — canonical here, linked everywhere else.

This page is the single source for every course policy. Calendar, Assignments, and Help all link back here instead of repeating it.



## Class Recordings (Panopto)

Recordings of each class session live in Canvas, under the Panopto tab.

## Course description

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**SYSEN 5300 — Systems Engineering and Six Sigma for the Design and Operation of Reliable Systems** (Cornell University). Course textbook: *Sigma: Quality and Reliability Engineering in R and Python*.

The purpose of this course is to develop fundamental concepts, analytical skills, and practical tools in the design, operation, and control of reliable systems — including Green Belt and Black Belt Six Sigma training — across a wide variety of system types. The course spans the complete spectrum of knowledge participants need to become active leaders in systems-reliability analysis/management and a Six Sigma initiative.

## Course learning outcomes

By the end of the course, students will be able to perform:

- **Risk analysis** — risk assessment and characterization, including Failure Modes and Effects Analysis (FMEA), fault trees, and event trees under uncertainty.
- **Modeling reliability** — component and system reliability, including physical acceleration models. Reliability is the ability of a system or component to perform its required function under stated conditions for a specified period of time; it is one element of the broader risk-analysis picture.
- **Quality control** — Six Sigma and statistical process control for quality monitoring and improvement, including detecting when performance is deteriorating so corrective action can be taken.
- **System improvement** — improvement and optimization of system design for reliability, via design of experiments and response-surface estimation that catalyze innovation, problem solving, and discovery.

## Who is this course for?

Any of the following make this course especially useful for your professional goals:

- ☐ Engineers who want to earn their Six Sigma Green Belt or Black Belt certification.
- ☐ Engineers who want to improve their statistics and data-science skills.
- ☐ Engineers and analysts who need to measure product reliability, run quality-control analyses, and design experiments for system improvement.
- ☐ Analysts who want to become proficient in an open-source programming language.

## Course info

Fall 2026

**Credits** 3 credits, with a 1-credit project option for the Six Sigma Black Belt.

**Prerequisites** None required. Suggested prior coursework: SYSEN 5100 and either OR&IE 2700 or CEE 3040. No prior statistics or coding experience assumed — we move quickly from zero.

**Format** Hybrid (on-campus and distance-learning).

**Sections** Register for one lecture + recitation pair: SYSEN 5300-001+201, SYSEN 6300-001+201, or MAE 5930-001+201 (in person); SYSEN 5300-002+202 (distance-learning only).

**Meets** Tue & Thu 1:25–2:40 PM, Fri 3:35–4:25 PM · Upson Hall 142.

## Staff & office hours

**Dr. Timothy Fraser** — Instructor  
[tmf77@cornell.edu](mailto:tmf77@cornell.edu) · Rhodes Hall 404

**Tolkien Bagchi** — Teaching Assistant  
[tb549@cornell.edu](mailto:tb549@cornell.edu)

Office hours run Tuesdays, Thursdays, and Fridays at varying times. See the current schedule and sign up at [bit.ly/office\\_hours\\_fraser](https://bit.ly/office_hours_fraser) ([https://bit.ly/office\\_hours\\_fraser](https://bit.ly/office_hours_fraser)).

## How the course works

### Weekly format

Fall 2026

- **Tuesday — Lesson.** Slides, boardwork, and discussion introducing the week's concept.
- **Thursday — Workshop.** Statistics & coding workshop applying the concept hands-on.
- **Friday — Recitation (mandatory).** Review session.

Coding trainings/tutorials should be completed before the week's first class.

## What's due, and when

Every week runs the same underlying rhythm: **class** ↔ **labs** ↔ **weekly deadlines posted on Canvas**.

- **Class** walks through the week's concept with a case study (the Tuesday Lesson, above).
- **Labs** — a hands-on Live Lab (see [Labs](#)) applying the concept to a live, unseen dataset. Labs run on the course server and open with your Cornell login — no access code. In-person students submit before leaving the room; distance learners submit by the following Monday.
- **Weekly deadline** — the week's learning checks (chapter MCQ + justification, see [Assignments](#)) and in-class activities are due; the exact cutoffs (earlier for on-campus, later for distance learning) are posted on each Canvas item.

See the [Calendar](#) for the day-by-day version of this rhythm.

## Six Sigma certification

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Green Belt and Black Belt certificates are signed by the Cornell Systems Engineering Program Director for course participants meeting the project and grade requirements below.

### Green Belt

Maintain good standing in course performance (**B+ or above**). Open to qualifying 3-credit or 4-credit students.

### Black Belt

Complete a Six Sigma course project (teams of up to ~3–4 students) **and** maintain good standing in course performance (**B+ or above**). 4-credit students only.

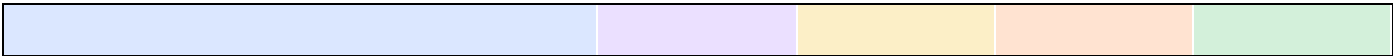
Students may also have the option to obtain a CSSC certificate — see Canvas for the current requirements.

## Grading breakdown

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Everyone in the course does the same six categories of work. The **project is for 4-credit students only** — it is the Six Sigma **Black Belt** track (see [Certification](#)). If you are registered for 3 credits you do *not* do the project, and the remaining five categories are rescaled to 100%.

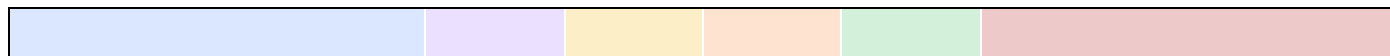
### 3-credit track — grade weights



- ☐ Homework — ≈42.9%
- ☐ Oral Exam — ≈14.3%
- ☐ Midterm Exam — ≈14.3%
- ☐ Hackathon — ≈14.3%
- ☐ Activities — ≈14.3%

Same requirements as the 4-credit track *minus the project*, rescaled: each 3-credit weight is its 4-credit weight divided by the remaining 70 points ( $30/70 \approx 42.9\%$ ,  $10/70 \approx 14.3\%$ ). Canvas does this rescaling automatically.

## 4-credit track (+ Six Sigma Black Belt project) — grade weights



- Homework — 30%   □ Oral Exam — 10%   □ Midterm Exam — 10%   □ Hackathon — 10%   □ Activities — 10%
- Project — 30%

**New for 2026:** the midterm take-home exam and the 24-hour Six Sigma Hackathon are **both required**. In past years they were an either/or choice — they are not anymore. Each is its own 10% (4-credit) /  $\approx 14.3\%$  (3-credit) category.

The lowest grade is dropped across **Homework 1–6 only** — six of the seven Homework Problem Sets count toward your final grade. **Homework 7 is the take-home final and cannot be dropped**; it always counts.

### What each category is

- **Homework — 30% /  $\approx 42.9\%$ .** Seven problem sets; the lowest of Homework 1–6 is dropped. Homework 7, the take-home final, is not droppable.
- **Oral Exam — 10% /  $\approx 14.3\%$ .** A short one-on-one conversation with a member of the teaching team about your project and about the course so far — nothing to upload, and no notes to bring. It is graded on whether you can explain your own work and reason out loud with the course's tools, not on recalling formulas. **Sign-up slots and times will be announced on Canvas.** Full description: [Assignments → Oral Exam](#).
- **Midterm Exam — 10% /  $\approx 14.3\%$ .** The take-home midterm. Required.
- **Six Sigma Hackathon — 10% /  $\approx 14.3\%$ .** The 24-hour hackathon. Required.
- **Activities — 10% /  $\approx 14.3\%$ .** Every in-class activity is submitted on Canvas and is worth 1 point, graded on completion — you get the point for doing the work, not for getting it right. The exception is **pop quizzes**, which are graded on accuracy. **Learning checks and the course surveys** (mid-semester, end-of-semester, teamwork & inclusivity) are 1-point activities too. **Participation is folded into this category** — there is no separate participation grade; showing up and engaging is what these activities measure.
- **Project — 30%, 4-credit students only.** The Six Sigma Black Belt project. 3-credit students do not have this category at all.

### Activity deadlines

**On-campus students** submit each activity by the in-class cutoff for that activity. **Distance-learning students** get a later cutoff — **one week** after the on-campus cutoff by default. Both cutoffs are shown on the Canvas item itself; the one that applies to you is the one Canvas shows you.

**After the cutoff, activity submissions lock.** Activities are worth 1 point and are simply closed once they lock — the 10%-per-day late penalty applies to homework and project work, not to 1-point activities. If you miss an activity, you miss that point; the dropped-lowest rule does not extend to activities.

## Assignments in detail

| Type         | Item                                    | Pts<br>(3cr) | Pts<br>(4cr) | Details                                                                                                                                                                                                                                                                                                                                  |
|--------------|-----------------------------------------|--------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Homework 1   | Failure Mode & Effects Analysis (FMEA)  | 7.15         | 5            | Apply FMEA to a hydrogen power park design. Risk analysis                                                                                                                                                                                                                                                                                |
| Homework 2   | Basic Statistics & Reliability Concepts | 7.15         | 5            | Calculate descriptive statistics and reliability estimates. Modeling reliability                                                                                                                                                                                                                                                         |
| Homework 3   | Statistical Process Control             | 7.15         | 5            | Perform statistical process control. Quality control                                                                                                                                                                                                                                                                                     |
| Homework 4   | Useful Life Distributions               | 7.15         | 5            | Evaluate life distributions, acceleration factors, and fault trees. Modeling reliability                                                                                                                                                                                                                                                 |
| Homework 5   | Regression                              | 7.15         | 5            | Apply regression to evaluate relationships between variables. Quality control                                                                                                                                                                                                                                                            |
| Homework 6   | Comparing Groups & ANOVA                | 7.15         | 5            | Apply t-tests and ANOVA to compare outcomes by group. System improvement                                                                                                                                                                                                                                                                 |
| Homework 7   | Factorial Experiments & RSM             | 7.15         | 5            | Factorial design and response-surface methodology. Doubles as the take-home final, covering material after the midterm. System improvement                                                                                                                                                                                               |
| Oral Exam    | Individual oral exam                    | 14.3 / 10    |              | A one-on-one conversation with the teaching team about your project and the course so far. Nothing to upload; the grade is entered by hand. <b>Sign-up and times announced on Canvas.</b> See <a href="#">Assignments → Oral Exam</a> .                                                                                                  |
| Midterm Exam | Midterm take-home exam                  | 14.3 / 10    |              | <b>Required.</b> Closed-book; one 8.5"×11" note sheet allowed. Covers material before the midterm.                                                                                                                                                                                                                                       |
| Hackathon    | Six Sigma Hackathon                     | 14.3 / 10    |              | <b>Required.</b> 24-hour hackathon applying basic statistics and control techniques.                                                                                                                                                                                                                                                     |
| Activities   | In-class activities                     | 14.3 / 10    |              | Every in-class activity is submitted on Canvas for <b>1 point, graded on completion</b> ; pop quizzes are graded on accuracy. Your Activities score is the share of the term's activity points you earn. Participation is folded in here — engagement is captured by the in-class activities, and there is no separate attendance grade. |
| Activities   | Learning checks                         | 1 pt each    |              | Weekly learning checks, counted as 1-point activities.                                                                                                                                                                                                                                                                                   |
| Activities   | Mid-semester survey                     | 1 pt         |              | Complete the Midterm Evaluation survey. Counts as a 1-point activity.                                                                                                                                                                                                                                                                    |
| Activities   | End-of-semester survey                  | 1 pt         |              | Complete the End-of-Term Evaluation survey. Counts as a 1-point activity.                                                                                                                                                                                                                                                                |

| Type               | Item                          | Pts<br>(3cr) | Pts<br>(4cr) | Details                                                                          |
|--------------------|-------------------------------|--------------|--------------|----------------------------------------------------------------------------------|
| Activities         | Teamwork & inclusivity survey |              | 1 pt         | Complete the peer teamwork/inclusivity assessment. Counts as a 1-point activity. |
| Project (4cr only) | Project activities            | —            | 10           | 10 weekly activities that help you draft portions of your report.                |
| Project (4cr only) | Rough draft                   | —            | 5            | Draft methods and results.                                                       |
| Project (4cr only) | Poster presentation           | —            | 5            | Present project results.                                                         |
| Project (4cr only) | Final report                  | —            | 10           | Summarize project findings.                                                      |

Full project deliverable timeline and submission mechanics: [Assignments](#) → [Project](#).

## Letter grade scale

Example: an 89.4 rounds to 89% (B+); an 89.6 rounds up to 90% (A-).

| Letter | A+  | A  | A- | B+ | B  | B- | C+ | C  | C- | D+ | D  | D- | F  |
|--------|-----|----|----|----|----|----|----|----|----|----|----|----|----|
| Max    | 100 | 96 | 93 | 89 | 86 | 83 | 79 | 76 | 73 | 69 | 66 | 63 | 60 |
| Min    | 97  | 94 | 90 | 87 | 84 | 80 | 77 | 74 | 70 | 67 | 64 | 61 | 0  |

## Policies

### AI policy

**No AI for writing.** Prose you submit in this course — justifications, writeups, project text — must be your own words. **No AI on quizzes, on the oral exam, or on the midterm**, in any form.

**AI for coding is allowed, but generally discouraged.** This course is your chance to actually learn how to code, and handing that work to a model spends the opportunity you came here for.

### Late work, extensions & regrades

**Late assignments are not allowed.** Work submitted after the due date is penalized 10% per day.

**Extensions** may be considered only under extreme extenuating circumstances (e.g. medical crisis, childcare, funeral). Students must request an extension in writing *before* the deadline.

**No curves** — as a general rule, there are no curves in this class.

**Regrade appeals** must be made to the instructor (cc'ing the TA), in writing, with justification referencing lecture notes or readings, within one week of the graded material being returned. The entire assignment is re-graded, not just the part in question — a regrade may raise or lower the score.

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## Accommodations

Cornell is committed to full inclusion for all students. Student Disability Services (SDS) determines eligibility for accommodations and works with students and instructors to arrange them. Contact SDS as early in the semester as possible: [www.sds.cornell.edu](http://www.sds.cornell.edu) (<https://www.sds.cornell.edu>), 607-254-4545. Your instructors are glad to help you get the accommodations you deserve.

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## Academic integrity

Every assignment must carry this signed pledge at the top:

*"I have neither given nor received unauthorized aid on this assignment. Signed: [Your Name Here]."*

We only grade assignments carrying this pledge — signing it is your word, and in exchange we assume you've told the truth. Students are expected to abide by the [Cornell University Code of Academic Integrity](https://theuniversityfaculty.cornell.edu/dean/academic-integrity/code-of-academic-integrity/) (<https://theuniversityfaculty.cornell.edu/dean/academic-integrity/code-of-academic-integrity/>). For homework, you're encouraged to help each other understand the material and develop solution strategies — but each student must work out and write up their own solution. If you collaborate on a spreadsheet, model, or tool, say so explicitly in your writeup and provide your own interpretation of the results. Plagiarism (copying answers, using Chegg/Bartleby, passing off others' work as your own) results in a zero and a report to the university, every time — for every member of a group, if it's a team assignment.

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## Personal conduct

The Systems Engineering Program expects respectful, professional participation and communication in every part of this course. Disrespectful, unethical, or unprofessional behavior will not be tolerated and can result in course failure and/or dismissal from the program.

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## Inclusive learning environment

Cornell supports an inclusive learning environment where diversity and individual differences are understood, respected, and recognized as a source of strength. Students are expected to respect differences and engage thoughtfully with perspectives, behaviors, and worldviews different from their own.

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## Mental health & stress resources

If you're feeling overwhelmed, or worried about a friend, reach out to an instructor or your academic advisor — we can help, or connect you with someone who can. Cornell's trained counselors: [Empathy, Assistance & Referral Service \(EARS\)](http://orgsync.rso.cornell.edu/org/ears) (<http://orgsync.rso.cornell.edu/org/ears>); [Cornell Health Counseling & Psychological Services \(CAPS\)](https://health.cornell.edu/services/counseling-psychiatry) (<https://health.cornell.edu/services/counseling-psychiatry>), 607-255-5155; [Let's Talk](https://health.cornell.edu/services/counseling-psychiatry/lets-talk) (<https://health.cornell.edu/services/counseling-psychiatry/lets-talk>). More at [mentalhealth.cornell.edu](https://mentalhealth.cornell.edu) (<https://mentalhealth.cornell.edu>).

## Materials & setup

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No purchase required. Every chapter runs in-browser via the Playground — nothing to install. If you'd rather work locally, see [Help → R setup](#) or [Help → Python setup](#) (Posit Cloud, or local Positron/RStudio).

### Software

Students will learn to code in R or Python. No prior experience with R or Python is required. The recommended software is [Positron](https://positron.posit.co/) (<https://positron.posit.co/>), a streamlined platform for data science. Everyone also completes a short [Posit Cloud](https://posit.cloud/) (<https://posit.cloud/>) setup activity, so you can run R and Python in the browser without installing anything. Projects and hackathon apps will be hosted on our program's Posit Connect instance.

### Recommended references (optional — not required)

- *Statistics for Experimenters: Design, Innovation, and Discovery*, 2nd ed. — Box, Hunter & Hunter (Wiley)
- *Applied Reliability*, 2nd ed. — Tobias & Trindade (Chapman & Hall/CRC)
- *Statistical Methods for Six Sigma in R&D and Manufacturing* — Joglekar (Wiley-Interscience)

### Data

Workshop and lab datasets are distributed from the public [GitHub course repository](https://github.com/timothyfraser/sysen) (<https://github.com/timothyfraser/sysen>).

## Project funding

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Students may apply for project funding support, when funds are available. Details TBA.