

## MME 3350B - System Modeling and Control

### COURSE OUTLINE – 2021-2022

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**CALENDAR DESCRIPTION:** Basic analytical techniques for modeling and control of dynamic systems. Solve for response as well as design controllers to shape response of systems. Applications to vibratory, thermo-fluidic, hydraulic, pneumatic and electro-mechanical systems.

**COURSE INFORMATION:**

Instructor: Dr. Samuel Asokanthan  
Professor  
Room: SEB 2059A  
Email: sasokant@uwo.ca

Lectures: M 9:30 – 10:30 am (SEB 2202)  
Tu 11:30 am – 12:30 pm (FNIB 3210)  
*(Note: synchronous meetings will take place on Zoom until at least 31 January on Mondays and Tuesdays slots)*  
Th 8:30 – 9:30 am (SEB 2202)  
*(Note: synchronous meetings will NOT take place until the normal in-class delivery resumes)*

Tutorials: W 3:30 - 5:30 pm (SEB 2202)  
*(Note: synchronous meetings will take place on Zoom until at least 31 January)*

Labs: M 2:30 -5:30 pm, Tu 8:30 – 11:30 am, Tu 1:30-4:30 pm, W 6:30 – 9:30 pm, Fri 1:30 – 4:30 pm. (SEB 3101)  
*(Note: Labs will not start until mid February, schedules will be posted in February along with information on the mode (ie. in-lab or simulation)*

**PREREQUISITES:** NMM 2270A/B or the former Applied Mathematics 2270A/B, MME 2273A/B, MME 3381A/B. 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.

**ACCREDITATION UNITS:** Engineering Science = 100%

**TOPICS:**

1. Brief discussions of the history of automatic control systems; Application of Laplace Transformations and the Inverse Transformation;
2. Modelling of Rigid-body, Spring-Mass, Electromechanical, Thermal, Hydraulic, and Pneumatic Systems.
3. Simulation of response using MATLAB and SIMULINK
4. Transfer functions, Block-Diagram Reduction, Response of First and Second Order Systems to Impulse, Step, Ramp and Decaying Exponential Inputs. Dominant-pole design based on time-domain response.
5. Stability analysis via Routh's stability criterion; use of feedback-control design to shape system response
6. Analysis of three-term PID (Proportional+Integral+Derivative) Controllers;
7. Root Locus Method; Controller design via Root Locus; Control design tools in MATLAB

8. Bode Plot; Controller design in the Frequency-Domain; Control design tools in MATLAB

**LEARNING  
OUTCOMES:**

Upon completion of this course students will be able to:

1. establish dynamic models that represent practical control problems that arise in automotive, aerospace and power-generation industries.
2. employ the developed models to predict dynamic behavior as well as design suitable controllers to shape system response.
3. analyze as well as design model-based controllers using computer-aided tools available within MATLAB/SIMULINK environment and understand the implementation issues.

**UNITS:**

S.I

**CONTACT HOURS:**

3 lecture hours, 2 tutorial hours, 0.5 Lab hour, half course

**TEXT:**

G. F. Franklin, J.D. Powell and A. Emami-Naeini, *Feedback Control of Dynamic Systems*, 8th Edition, 2019, Prentice Hall, New Jersey ISBN-13: 9780134726076. Online edition available from the publisher at a lower price.

**REFERENCES:**

TBA

**EXAMINATIONS  
AND QUIZZES:**

Mid-term and Final Examination

**EVALUATION:**

The final grade is computed as follows:

<b>Individual Assignments</b>	<b>10%</b>
Assignment 1: Due week of Jan 31 (tentative)	2.5%
Assignment 2: Due week of Feb 28 (tentative)	2.5%
Assignment 3: Due week of Mar 21 (tentative)	2.5%
Assignment 4: Due week of Apr 4 (tentative)	2.5%
<b>Quizzes (45 mins each)</b>	<b>15%</b>
Quiz 1: Week of Feb 7 (tentative)	7.5%
Quiz 2: Week of Mar 21 (tentative)	7.5%
<b>Laboratories (Two Labs)</b>	<b>15%</b>
<b>Mid-term Examinations (2 hours)</b>	
Week of Mar 7 (tentative)	<b>20%</b>
<b>Final Examination (3 hours)</b>	<b>40%</b>
Date during examination period TBA	

All examinations will be **closed-book**. A **Formula sheet will be provided (single side sheet for the mid-term and double sided sheet for the final exam)**. Quizzes will be **OPEN-BOOK/OPEN NOTES**.

If a minimum mark of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.

Assignments will provide minimal (but sufficient) experience to master each aspect of the course. Assignment marks will be composed of **completion (80%)** and **mark for ONE randomly selected question (20%)**. Marks will be deducted for late submissions of assignments.

**CONSULTATION  
HOURS:**

Office hours: TBA (or by appointment)

**COURSE  
POLICIES:**

**The following course-specific policies will be enforced throughout the course while functioning in an online-only scenario. These may supersede the normal policies outlined after:**

**Computer requirements**

- All students are required to have a computer with a functional camera and microphone. These two accessories will be required for all term tests, final exam as well as when asking questions during synchronous/live sessions (classes and tutorials).
- If Zoom will be used for term test/exam invigilation, you will be required to keep your camera on for the entire session, hold up your student card for identification purposes, pan the room and share your screen with the invigilator if asked to do so at any time during the exam. The exam session using Zoom will not be recorded.
- Completion of this course will require you to have a reliable internet connection.
- Completion of this course will require you to have a device that meets the system and technical requirements for Zoom, and Matlab/Simulink. Information about the system and technical requirements are easily found online.

**Online Class Demeanor/Netiquette**

Some components of this course will involve online interactions. To ensure the best experience for both yourself and your classmates, please abide the following rules:

- All live sessions will take place via Zoom meetings. The links to be accessed for each class will be posted in OWL.
- You will be required to authenticate in the Zoom meeting with your Western credentials only (SSO authentication on the westernuniversity.zoom.us domain). In the event you attempt to authenticate in the Zoom meeting with different credentials, you will be removed from the online session without any warning.
- Please ensure that your Zoom participant name matches the one from the official class roster. Failure to do so will mean that you will be removed from the online session without any warning.
- Please connect to the Zoom sessions on time.
- Please use a Windows or Mac computer to connect to the Zoom meeting as opposed to a mobile device (i.e., cell phone or tablet).
- Please ensure that you are in a private location to protect the confidentiality of the class discussions (if applicable).
- **Turn on your camera!** It is *very* hard to speak to a Zoom audience when you have no idea whether they are there. Participation means you are there, and if I can't see you, I don't know if you are there.
- Please do not share your screen during the meeting unless asked by the instructor.

The course instructor or TA will act a moderator of the online live session and will attempt to answer the questions received from Zoom meeting participants. In this regard, please consider the following:

- If you wish to speak during the live meeting, please use the “raise hand” feature in Zoom and wait for the instructor to nominate you to speak.
- Please remember to unmute your microphone before speaking.
- Please self-identify yourself at the beginning of your comment.
- Please put down (off) your “virtual hand” after speaking.

Some general considerations pertaining to “netiquette”:

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- Please be mindful of the possibly different cultural and linguistic background of Zoom meeting participants.
  - Be courteous with all Zoom meeting participants.
  - Be respectful of the diversity of viewpoints that you will encounter in the class since the exchange of diverse ideas and opinions is an essential component of the academic environment. However, please keep in mind that practices such as “flaming” are an unacceptable behavior.
  - Be professional in all online postings and questions.
  - Please note that disruptive behavior of any type to occur during online classes (including inappropriate use of the chat function) is unacceptable.
  - Students found guilty of “Zoom-bombing” a class or of other serious online offenses may be subject to disciplinary measures covered by the Code of Student Conduct.

### **Course Content**

- Lecture notes and online lecture videos are copyrighted to the instructor and hence they are legally protected.
- As such, the unauthorized posting and sharing of the copyrighted course content could be subjected to legal actions.
- Along the same lines, the recording of the live/synchronous sessions of the course by the students is strictly prohibited. Important live-sessions will be recorded by the instructor and will be made available to the class via OWL.

### **Laboratory sessions**

- More details on the sessions, procedures will be announced at the appropriate time depending on the mode of laboratory sessions.

### **Online evaluations (quizzes, tests, midterms, examinations)**

- If required, quizzes, midterms and examinations may be administered online using the most appropriate modality practiced at the time.
- For these evaluations, it is **required** that each student have a working web camera, setup to allow proctors to observe the student writing the test (typically a side profile view and, preferably, in front of a mirror). Students may be requested to offer video evidence that they are working independently.
- A printer and scanner are also strongly recommended. However, a phone may be used to scan and upload completed work.
- If technical issues arise during the online evaluation which will prevent a student from successfully completing and submitting their work, the student will communicate those to a proctor or (if that is not possible) the course instructor, immediately. If the technical issue cannot be resolved, the weight of the evaluation may be automatically shifted to the final exam or a make-up may be offered; depending on the nature of the evaluation, at the instructors discretion.
- If cheating during the online evaluation is suspected, the student will be required to participate in a one-on-one oral evaluation with the instructor. The mark obtained in the oral evaluation will supersede the one obtained previously. If the student refuses his/her participation in the oral evaluation, they will be automatically graded with zero and further academic penalties for scholastic offences will be applied.
- Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

**The following course-specific policies will be enforced throughout the course (online or in person):**

**Midterm examination**

- The exam will be administered using the most appropriate modality practiced at the time (whether online or in person).
- Only non-programmable calculators will be allowed during the midterm examination.
- A student who misses the midterm **without** academic consideration will receive a zero mark for the midterm.
- Should a student miss the midterm **with** academic consideration, there will be no make-up midterm, however the value of the midterm will be shifted to the final exam.
- If cheating during the midterm is suspected, the student will be required to participate in a one-on-one oral examination with the instructor. The mark obtained in the oral examination will supersede the one obtained during the written midterm. If the student refuses his/her participation in the oral examination, the midterm will be automatically graded with zero and further academic penalties for scholastic offences will be applied.
- Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

**Final examination**

- The exam will take place during the Spring examination period. Its timing will be announced in advance.
- The exam will be closed book.
- The exam will be administered using the most appropriate modality practiced at the time (whether online or in person).
- The length of the final exam will be two and a half hours.
- If a minimum of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.
- If cheating during the final examination is suspected, the student may be required to participate in a one-on-one oral examination with the instructor. The mark obtained in the oral examination will supersede the one obtained during the written exam. If the student refuses his/her participation in the oral examination, the final exam will be automatically graded with zero and further academic penalties for scholastic offences will be applied.
- Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

**Final course grade – alternative weighting scheme**

- For eligible students, the contributions of the midterm and final exam to the final course grade will be automatically selected from the two options below, based on whichever is most beneficial for the student's final course grade:
  - Option 1: Midterm and final exam grades contribute to final course grade according to the distributions described in the "Evaluation" section.
  - Option 2: Midterm grade is ignored, and weight is shifted to the final exam.
- To be eligible for Option 2, students must have attempted and received a grade of at least 50% on the midterm, and received a cumulative grade of at least 50% for the Assignments, quizzes and the labs.
- Students with academic accommodations for the midterm and those who experienced severe technical difficulties during the midterm which could not be resolved after contacting the proctor or course instructor will automatically be graded according to Option 2, regardless of other course component grades.

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- ATTENDANCE:** Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.
- CHEATING:** University policy states that cheating, including plagiarism is a scholastic offense. 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. Scholastic offences are taken seriously and students are directed to the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: [uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)
- SSD:** Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.
- NOTE:** The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (ie.<50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

January 18, 2022

**INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED**

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

**NEW: Requests for Academic Consideration using the Self-Reported Absence Form**

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link [here](#).

**A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)**

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

**B. TERM/MIDTERM TESTS (other than self-reported absences)**

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

**C. FINAL EXAMINATIONS (cannot be self-reported)**

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
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 sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

**PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.**

**D. LATE ASSIGNMENTS**

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
  - i) 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.
  - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

**E. SHORT ABSENCES**

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

**F. EXTENDED ABSENCES**

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

**G. DOCUMENTATION**

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

**In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**For Other Extenuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

**Note:** Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).



## H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

**Calendar References:** Check these regulations in your 2021 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

[Self-Reporting Absences](#)  
[Absences Due to Illness](#)  
[Academic Accommodations for Students with Disabilities](#)  
[Academic Accommodations for Religious or Holy Days](#)  
[Course Withdrawals](#)  
[Examinations](#)  
[Scheduling of Term Assignments](#)  
[Scholastic Offences](#)  
[Student Medical Certificate](#)  
[Engineering Academic Regulations](#)

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

<b><u>Add Deadlines:</u></b>	First term half course (i.e. “A” or “F”)	September 16, 2021
	Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 16, 2021
	Second term half course (i.e. “B” or “G”)	January 11, 2022

<b><u>Drop Deadlines:</u></b>	First term half course (i.e. “A” or “F”)	November 12, 2021
	Full courses and full-year half courses (i.e. “E”, “Y” or no suffix)	November 30, 2021
	Second term half or second term full course (i.e. “B” or “G”)	March 7, 2022

### **Contact Information:**

Undergraduate Services Office	SEB 2097 Phone: 519-661-2130	E-mail: <a href="mailto:engugrad@uwo.ca">engugrad@uwo.ca</a>
Chemical & Green Process Engineering	TEB 477 Phone: 519-661-2131	E-mail: <a href="mailto:cbeugrad@uwo.ca">cbeugrad@uwo.ca</a>
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: <a href="mailto:civil@uwo.ca">civil@uwo.ca</a>
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279 Phone: 519-661-3758	E-mail: <a href="mailto:eceugrad@uwo.ca">eceugrad@uwo.ca</a>
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: <a href="mailto:engceli@uwo.ca">engceli@uwo.ca</a>
Mechanical Engineering	SEB 3002 Phone: 519-661-4122	E-mail: <a href="mailto:mmeundergraduate@uwo.ca">mmeundergraduate@uwo.ca</a>

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