

MME 3350B - System Modeling and Control

COURSE OUTLINE – 2023-2024

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

Lecture, tutorial and lab schedules: <https://draftmyschedule.uwo.ca/login.cfm>

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.

ANTIREQUISITES CBE 3310A/B.

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:

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| Individual Assignments | 10% |
| Assignment 1: Due week of Jan 29 (tentative) | 2.5% |
| Assignment 2: Due week of Feb 26 (tentative) | 2.5% |
| Assignment 3: Due week of Mar 18 (tentative) | 2.5% |
| Assignment 4: Due week of Apr 1 (tentative) | 2.5% |
| Quizzes (45 mins each) | 12% |
| Quiz 1: Week of Feb 5 (tentative) | 7.5% |
| Quiz 2: Week of Mar 25 (tentative) | 4.5% |
| Laboratories (Two Labs) | 13% |
| Mid-term Examinations (2 hours) | 20% |
| Week of Mar 11 (tentative) | |
| Final Examination (3 hours) | 45% |
| 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:**

Midterm examination

- The exam will be administered using the most appropriate modality practiced at the time
- Only non-programmable calculators will be allowed during the midterm examination.

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- 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 Associate Chair Undergrad will investigate and will determine an appropriate resolution. This may range from completing a one-on-one oral examination with the instructor, to receiving a grade of zero on the midterm, to further academic penalties for scholastic offences applied by the Associate Dean Undergrad.
 - 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 Limited open book with instructor provided formula sheet.
- The exam will be administered using the most appropriate modality practiced at the time
- The length of the final exam will be three 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 Associate Chair Undergrad will investigate and will determine an appropriate resolution. This may range from completing a one-on-one oral examination with the instructor, to receiving a grade of zero on the exam, to further academic penalties for scholastic offences applied by the Associate Dean Undergrad.
- 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.

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.

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- 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
- 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.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

Western [is committed to reducing incidents of gender-based and sexual violence](#) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
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

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 and request relief through the [Academic Consideration Request Form](#). 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, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the [Academic Consideration Request Form](#) and 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 submit an "[Application for a Special Exam](#)" form. 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 submit the [Academic Consideration Request Form](#) and 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 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

<http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=>

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

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.

Add Deadlines:

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| First term half course (i.e. “A” or “F”) | September 15, 2023 |
| Full courses and full-year half course (i.e. “E”, “Y” or no suffix) | September 15, 2023 |
| Second term half course (i.e. “B” or “G”) | January 16, 2024 |

Drop Deadlines:

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| First term half course without penalty (i.e. “A” or “F”) | November 13, 2023 |
| Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix) | November 30, 2023 |
| Second term half or second term full course without penalty (i.e. “B” or “G”) | March 7, 2024 |

Contact Information:

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

December 7, 2023