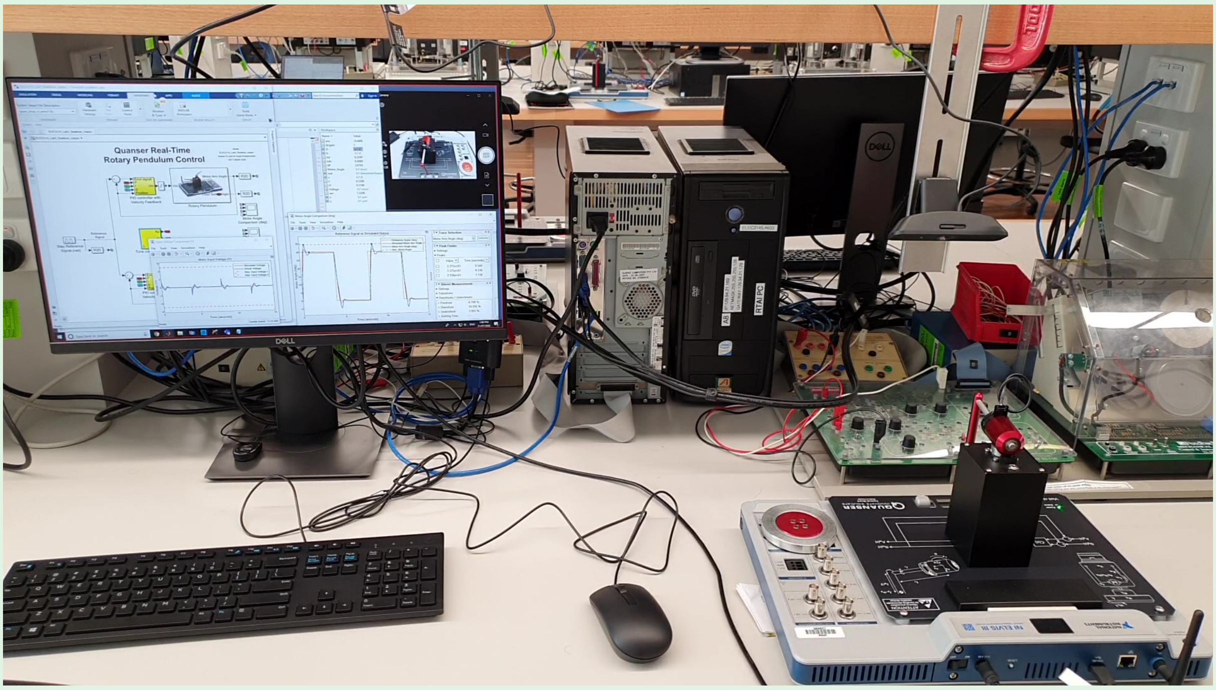
School of Electrical Engineering & Telecommunications

UNSW Engineering

ELEC3114

Control Systems

Term 2, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Arash Khatamianfar	a.khatamianfar@unsw.edu.au	By appointment	Room 313, EE&T Building (G17)	+61 2 9385 5231

Lab Staff

Name	Email	Availability	Location	Phone
Cameron Jones	cameron.jones@unsw.edu.au	By appointment		

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC/TELExxxx in the subject line; otherwise, they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Student Support Enquiries

For enrolment and progression enquiries please contact Student Services

Web

Electrical Engineering Homepage

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

Course Details

Units of Credit 6

Summary of the Course

The Control Systems course is a third-year core course offered in the School of Electrical Engineering and Telecommunications at the undergraduate level. Control systems engineering is one of the **most multidisciplinary subjects** in Engineering, and as such, relies heavily upon prior foundational courses taken in the Electrical Engineering degree. This is because most modern control systems are themselves the synthesis of multiple electromechanical, hydraulic and embedded systems in one coherent structure. The successful design of control systems is an example of the '*marriage between theory and practice'*, where the various powerful mathematical tools from control theory are successfully applied to real-world control engineering problems. The study of control theory enables us to translate these practical problems into workable engineering solutions.

For instance,

- *Have you ever thought about how your air-conditioning system in your car automatically regulates the temperature inside the cabin when you set your preferred value on the front panel, even when your vehicle moves into and out of shade?*
- *Have you ever come across or heard about the autopilot feature on a Tesla automobile?*
- *Have you seen how adaptive cruise control maintains your vehicle at a safe distance from the car ahead no matter how fast or slow they drive (see* this guide *in Mathwork website)?*

Course Aims

The objective of this course is to equip you with the fundamental tools of control theory required for the design and implementation of these control systems. These tools are broadly applicable to other disciplines and are not just limited to the examples discussed above. For example, control theory is utilised in financial systems, unmanned aerial and underwater vehicles, and also in the control of disease spread in a population. In this course, we are only going to touch the surface of this vast field, but we hope that you take away valuable transferable skills which could be applied to a multitude of practical engineering problems.

To support your learning, the laboratory component of this course has been carefully designed to help you develop the ability to design real control systems from scratch. It is our hope that through the complementary activities within lectures, tutorials and the laboratories, you learn how to analyse and implement effective control strategies for real-world systems considering practical challenges, such as hardware limitations and external disturbances.

This course is challenging, but we will cater the learning and teaching process to your needs in a way that encourages active learning and participation through proven *learner-centred approaches*. As such, we will be holding several in-class and out-of-class learning activities to keep you engaged with the material, to be motivated to learn more, to develop critical thinking skills which is broadly applied to real engineering problems, and become lifelong learners. As mentioned previously, the laboratory exercises and experiments are going to be a crucial part of this course as they will provide you with the necessary hands-on experience to develop these skills.

In summary, the overall objective of this course is for you to gain true competence in the fundamentals of control theory, and also to learn how to:

- Examine a physical process and abstractly represent it in block diagram form,
- Assess whether it may be difficult or easy to control the process,
- Specify a reasonable control performance in the view of input constraints,
- Design a simple controller to achieve that performance, and
- Deploy the controller to real hardware and be able to tune the controller to meet the design specifications in a laboratory environment.

The fundamentals that will enable you to achieve these are:

- Feedback and feedforward concepts,
- Response of linear time-invariant (LTI) systems to standard inputs,
- Analysis of stability and robustness in linear systems, and
- Design of linear feedback systems capable of achieving specified performance criteria.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Identify an approximate linear/linearized model for a physical dynamic system.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
2. Analyse linear time-invariant (LTI) systems in both time domain and frequency domain.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
3. Understand the concept of control systems stability and feedback control systems.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
4. Apply time-domain and frequency-domain techniques to analytically design linear control systems.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
5. Acquire practical skills in applying control systems theories through hands-on and in-depth experience in laboratory.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
6. Utilize software tools to help with analysis, design, evaluation, and implementation of control systems for real-world applications in both simulation and real-time environment.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3

Teaching Strategies

Delivery Mode

The teaching in this course aims to establish a good fundamental understanding of the aforementioned areas, using:

- **Formal lectures** (synchronous lectures both catered for in-person and online attendance), which focuses on the core analytical material in the course, together with qualitative and alternative explanations to aid your understanding.
- **Tutorials**, which allow you to practice problem solving techniques and troubleshooting the

problems you might have in understanding lecture material, as well as performing formative learning activities through ***flipped*** tutorials.

- **Laboratory sessions** (in-person and remotely-accessed), which support the formal lectures and tutorials and provide you with practical construction, measurement and debugging skills for control systems analysis and design.
- **Recorded lecture videos**, which support the scheduled lectures for revision purposes. Please note that watching recordings is **no substitute** for attending the live lectures, where questions can be asked. Please note that *having access to recorded lectures does not imply improved exam preparation*, *without significant and consistent additional self-directed study throughout the term.*
- **Online review quizzes,** which allow you to review the lecture topics by completing small periodic quizzes online for feedback on your progress and performance in the course.
- The main platform for course delivery is **MS Teams.** However, **Moodle** is mainly used for **online quizzes, assignment submissions** and **online Final exam** and for any other activities that are not available in MS Teams. All **announcements** will be made primarily on MS Teams. So please make sure your **MS Teams Notification** setting for **ELEC3114** Teams Class is enabled on your devices.

Learning in this course

You are expected to *attend all lectures*, *tutorials and laboratories* in order to maximize your learning. You must prepare well for your laboratory classes and your lab work will be assessed. In addition to the lecture notes/video, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. *Group learning is highly encouraged*. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending formal classes throughout the course.

Tutorial classes

Tutorial classes are scheduled for **2x1.5 hours per week starting from Week 2**. MS Teams will be used to live-stream the tutorials where you will have the chance to discuss the problems with your tutor. These tutorials are problem solving sessions. A variety of worked tutorial questions will be available online, including some recorded tutorials from previous years. A selection of the tutorial problems will be solved during the tutorials to elaborate on the problem solving techniques. The rest of the tutorial will be dedicated to **flipped mode** and for students' consultation. It is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

You should try to attempt all the problem sheet questions before attending the tutorial classes. The importance of *adequate preparation prior to each tutorial cannot be overemphasized*, as the effectiveness and usefulness of the tutorial depends to a large extent on your preparation.

Laboratory program

The laboratory classes are scheduled for **3 hours per week starting from Week 2** with Remote Lab familiarisation, mainly for online students, but also compulsory for in-person students in case they have to self-isolate due to the ongoing COVID-19 pandemic. The lab experiments have been deliberately designed to provide practical, hands-on exposure to the concepts covered in lectures soon after they are covered in class. You are required to attend all laboratories to pass the lab component of the course.

In response to COVID-19 in early 2020, a new system of **remote labs** was developed by Dr. Arash Khatamianfar in collaboration with the professional staff and top students in the School of EE&T and was deployed across many other courses. This allows students to get access to the lab computer remotely via MS Teams. This new approach enables students to still work in pairs similar to the in-person labs. Students can work collaboratively to control the lab equipment and will have access to live video feed of the device being controlled. The remote labs are reserved only for students who are stuck overseas due to border closures or when students must self-isolate. The rest of students must attend the labs in person.

Laboratory Exemption: *There is* ***NO*** *laboratory exemption for this course*. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course must successfully complete the laboratory component of this course. If, for medical reasons, you are unable to attend a lab (note that a valid medical certificate must be provided), you will need to request to attend the catch-up labs, arranged by the head lab demonstrator.

Additional Course Information

Syllabus

Recognition of what a control system is, and the distinction between simple and complex control systems. Analysis and design tools for dealing with simple control systems: Differential equations, Laplace transforms, transfer functions, poles and zeros, state space models, modelling, first and second order systems, stability, steady-state errors, root locus, Bode plots, transient response analysis and design, PID control, simple frequency response techniques. Stability of feedback control systems via the analysis of transfer function and state-space models.

Relationship to Other Courses

This is a 3rd year course in the School of Electrical Engineering and Telecommunications. It is a core/elective course for students following a BE and BE ME (Electrical) or (Telecommunications) program and other combined-degree programs. Related courses are shown in Fig. 2 below. Solid arrows indicate hard pre-requisites, while dashed arrows indicate soft pre-requisites.

Pre-requisites and Assumed Knowledge

The pre-requisites for this course are MATH2099, and ELEC2134. It is also useful that you are familiar with ELEC3104 Digital Signal Processing and DESN2000 (Electrical Stream) Embedded Systems Design before this course is attempted (not that critical though). Mechanical and mechatronics engineering students are welcome to take the course as the prerequisites for them can be replaced with MATH2089 and MATH2019.

Following Courses

This course is a pre-requisite for ELEC4631 Continuous-Time Control System Design, ELEC4632 Computer Control Systems, ELEC4633 Real-Time Engineering, and ELEC4123 Electrical Design Proficiency.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Lab Assessment	30%	Not Applicable	1, 2, 3, 4, 5, 6
2. Final Examination	35%	Not Applicable	1, 2, 3, 4
3. Quizzes	5%	Not Applicable	1, 2, 3, 4, 6
4. Midterm Examination	30%	Fri of Week 5 and Week 9 (see description for more details)	1, 2, 3, 4

Assessment 1: Lab Assessment

Laboratories reinforce both theoretical and practical learning, and thus the laboratory assessment is **worth 30 marks** of your **total course mark,** including **a Lab exam**. You must achieve **at least 15 out of 30** of the total lab marks to ***PASS* the course** (double-pass criteria). You are required to keep records of your observations either in digital or paper-based form and present these observations during assessment. There are **6 assessable lab experiments** (**24% marks** of your total lab assessment, that is 4 marks per lab) which are scheduled for **3 hours per week** (there is a familiarization Remote Lab practice which is not assessed). To increase the effectiveness and efficiency of learning through a self-directed learning approach, a new format of lab assessment has been developed as below since 2020 including **Pre-lab Exercises and Pre-lab Quizzes, Lab Exercises, Post-lab quizzes, and Lab exam**.

Assessment criteria

1. **Pre-lab Exercises and Pre-lab Quizzes**
    - You MUST complete the Pre-lab exercises **before attending** the lab. These include both simple analytical questions and simulation exercises using *MATLAB* and *Simulink* that serve as **crucial preparation** for the actual lab experiment. You will **NOT** be able to complete lab experiments if you do not attempt the Pre-labs before coming to the lab.
    - The Pre-lab exercises serve as **formative assessment**, which means they will **not** be marked. However, lab demonstrators (lab demos) will check if you have completed them at the beginning of each lab. This is to ensure that if you *run out of time* in completing the checkpoints due to NOT having completed the Pre-lab exercises, you will NOT be eligible for catch-up labs in Week 6 and Week 10.
    - You must also attempt a short **Pre-lab quiz** before attending the lab. It is based on your understanding of the pre-lab exercises. They serve as a **reflection on your learning** from pre-lab exercises, and thus, should be completed after you have finished your Pre-lab exercises. You have up to **3 attempts** to complete this quiz.
    - You can still complete each Pre-lab quiz **over the lab week** until **Sun 11pm** without any penalty (if you have not done so before attending your Lab session).
    - The **Pre-lab online quiz for each lab** is worth **10%** of the mark of that lab (that is 0.4 marks per lab).
    - You can discuss any questions that you have about the Pre-lab exercises with a lab demo at the start of your lab.
2. **Lab Exercises**
    - You are expected to *work in pairs* and must maintain a record of your observations in

either a digital or written form. This includes all your observations, results, working, and answers to the lab questions. These records must be presented during assessment.
    - There are **3 checkpoints** for each lab. After finishing each checkpoint, you must send a request for marking through a purpose-made **MS Form** (more details will be provided in the relevant lab documents including the new **MS Teams Dashboard**). You will be able to see your position on the Dashboard. When all prior students have been assessed, a lab demo will attend to you to assess your work. However, you should continue working towards the next checkpoint if the waiting list is long. The Dashboard will be used for requesting general query about the experiments as well.
    - Your work will be assessed based on **satisfying the task requirements** (**Req**) and also on your **understanding of the experiment** (**Und**). The **Req** mark is worth **40%** of the mark for each lab (that is 1.6 marks per lab). The **Und** mark is worth **50%** of the mark for each lab (that is 2 marks per lab). A variety of understanding questions will be asked which are related to the lab exercises and the experiment. You may also be asked about some of the Pre-lab questions and Pre-lab quiz as it is assumed that you have completed them before attending the lab.
    - Please note that the **Req** mark is **capped** by the **Und** mark. This means that if you cannot satisfactorily answer the understanding questions, particularly those from the Pre-labs, regardless of whether all of your results are correct, your Req mark will be reduced. Additionally, please be aware of the consequences of **plagiarism and cheating** as we will NOT tolerate any form of plagiarism. Repeated plagiarism will result in a mark of **zero** for the entire laboratory component of the course, and consequently fail mark for the course.
3. **Post-lab quizzes**
    - You **must** attempt a short **Post-lab quiz** after your lab is finished. This serves as a **reflection** on your lab exercises. This set of Post-lab quizzes is a **formative assessment**.
    - However, if you do **NOT** complete Post-lab quizzes, you will **forfeit** all of the marks from your **Pre-lab** quizzes. You must answer **4 correct questions out of 5** (mostly) to have the quiz shown as completed.
    - You can complete each Post-lab quiz **over the lab week** until **Sun 11pm** without any penalty. However, it is highly recommended that you complete this Post-lab quiz a couple of hours or right after the lab with your lab partner. This is in fact encouraged.
4. **Lab Exam**
    - To check that you have achieved practical learning outcomes for the course, you will be examined in the lab in **Week 10.**
    - Lab Exams could include practical work, simulations, and analytical calculations. The exam questions will be based on what you have learned in your labs including all Pre-lab, lab, and Post-lab exercises and quizzes, as well as any relevant lecture materials related to the lab experiments.
    - Marks will be awarded for **achieving correct requirements** of the exam tasks and **understanding** of practical and relevant theoretical concepts.
    - This exam is **worth 6 marks** of your total lab assessment.

Warning: It is of **paramount importance** that you ***complete Pre–lab exercises before coming to each lab*** since the content of lab experiments heavily relies upon the Pre-lab work. It is ***infeasible*** to finish the lab experiments on time if you have NOT completed the Pre-lab exercises beforehand. You should *NOT expect* your lab demos to sacrifice their time in helping you do the Pre-labs during the lab, which would be otherwise be utilised to mark and help those who have correctly finished their Pre-lab exercises before the lab. We believe that it is OK to collaboratively complete the Pre-lab exercises with your lab partner and your friends (but not the Pre-lab Quiz). However, any attempt to directly *COPY* the results from others without trying to learn how the questions should be solved, or how the simulations should be done, will result in a ***mark of zero*** for that lab (i.e. all marks will be forfeited for that lab). The UNSW rules and policies on **plagiarism** have been provided in the OTHER MATTERS section this document.

Laboratory guidance videos will be made available to help you get familiar with lab equipment and how to conduct the experiments and do simulations.

Assessment 2: Final Examination

The final exam in this course is a standard **2-hour written examination**, comprising **five** compulsory questions and it is **worth 35%** of your total course mark.

- University approved calculators are allowed.
- The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion.
- The final exam will be held online (more information will be provided close to the end of the term on how the exam will be run remotely as arrangements may change by the university).
- Questions may be drawn from any aspect of the course (including the labs), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses.
- Please note that you must ***PASS*** the final exam in order to ***PASS*** the course (necessary condition). This means you must achieve at least **40 marks out of 100 marks of final exam paper**. This is equivalent to attaining at least **14 out of 35 marks** of the Final exam contribution to total **course mark**.

After the marks from all of the assessments have been compiled, if your total course mark is **greater than or equal to 50**, you will pass the course, assuming you have attained a minimum of 15% out of 30% of the Lab mark as well as 14% out of 35% from Final exam.

Assessment 3: Quizzes

Each week starting from **Week 3**, there will be an online quiz related to the materials covered in the previous weeks of the course:

- These are weekly quizzes to review the content delivered in the previous week.
- Once the quiz is made available online, you can complete the quiz at your own pace.
- The **deadline** for each review quiz is **one week** from its opening date.
- The length of each quiz may vary depending on the difficulty level of that quiz.
- You have **5 attempts** at each of review quizzes before they are closed.
- The overall mark for review quizzes is **worth 5%** of the **total course mark**.

The *highest mark* from all of your attempts will be your final mark for each quiz. But you will not receive the correct answers or whether or not it's correct or wrong until the quiz is closed.

Assessment 4: Midterm Examination

Due date: Fri of Week 5 and Week 9 (see description for more details)

Midterm assignments

There are two assignments that you need to submit throughout the term.

- **Assignment A** is due on **Friday of Week 5.** It covers most of the topics up to the end of Week 4.
- **Assignment B** is due on **Friday of Week 9**. It covers most of the topics up to the end of Week 8.
    - Due to situational factors, the deadline and the release of the assignments might vary, but you will always be given one full week to complete the assignments.
- They will be **released** at least **one week before the deadline**.
- Each assignment is **worth 15% of the total course mark**.
- You will submit the assignment online on Moodle.
- These assignments will test your general understanding of the course material and are designed to give you feedback on your progress through the analytical component of the course.
- Questions will be drawn from any material already covered in the course schedule.
- They may contain questions requiring some basic knowledge of the lab material as well as supporting simulations.
- There could also be open-ended questions.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

The course consists of the following learning activities:

- **4 hours** of **lecture** (two 2-hour hybrid lecture sessions from **Week 1** to **Week 10**)
    - **Online** via **MS Teams** (synchronous)
    - **In-person** in **Room 102** in EE&T Building on Level 1 (G17 Building)
        - Maximum **capacity** of **70**
- **3 hours** of **tutorial** (two 1.5-hour hybrid tutorial/workshop sessions from **Week 2** to **Week 10**)
    - **Online** via **MS Teams** (synchronous)
    - **In-person** in **Room 102** in EE&T Building on Level 1 (G17 Building)
        - Maximum **capacity** of **70**
- **3 hours** of **laboratory** (hybrid mode from **Week 2** to **Week 10**, please see the notes)
    - **Remote lab** via **MS Teams**
    - **In-person** in Lab **EE109**

View class timetable

Timetable

Date	Type	Content
Week 1: 30 May - 3 June	Lecture	**Lec 1:** Introduction to Control Systems **Lec 2:** Mathematical Models of Systems
Week 2: 6 June - 10 June	Lecture	**Lec 3:** Permanent Magnet DC Motor **Lec 4:** State Variable Models
	Laboratory	**Lab 0:** Remote Lab Familiarisation
Week 3: 13 June - 17 June	Lecture	**Lec 5:** Time Response of LTI Systems **Lec 6:** Feedback Control System Characteristics
	Laboratory	**Lab 1:** MATLAB & Simulink Training
Week 4: 20 June - 24 June	Lecture	**Lec 7:** Stability of LTI Systems **Lec 8:** Steady State Error
	Laboratory	**Lab 2:** DC Motor Modelling with Load
Week 5: 27 June - 1 July	Lecture	**Lec 9:** PID Controllers
	Laboratory	**Lab 3:** Flexible Joint Robotic Arm Modelling
	Assessment	***Assignment A due date*** (if released by Week 4)

Week 6: 4 July - 8 July	Lecture	***Flexibility Week***
	Laboratory	***Catch–up lab for Labs 1 to 3*** *(Potential Arduino Training)*
Week 7: 11 July - 15 July	Lecture	**Lec 10:** State Variable Feedback Systems
	Laboratory	**Lab 4:** DC Motor Speed Control
Week 8: 18 July - 22 July	Lecture	**Lec 11:** Root Locus Technique
	Laboratory	**Lab 5:** DC Motor Position Control
Week 9: 25 July - 29 July	Lecture	**Lec 12:** Frequency Response Method
	Laboratory	**Lab 6:** Flexible Joint Robotic Arm Control
	Assessment	***Assignment B due date*** (if released by Week 8)
Week 10: 1 August - 5 August	Lecture	**Lec 13:** Sensitivity Analysis **Lec 14:** Catch-up lecture (in case we run out of time to finsh the content)
	Laboratory	***Lab Exam***
Study Week: 8 August - 11 August	Laboratory	***Catch–up lab for Labs 4 to 6 on Monday***

Resources

Prescribed Resources

Prescribed textbooks

- R.C. Dorf and R.H., Bishop, *Modern Control Systems*, 13th Edition., Harlow: Pearson.
- N. S. Nise, *Control Systems Engineering*, 7th or 8th Edition, John Wiley & Sons.

The majority of the content presented in the lectures will be from the first textbook. Occasionally, some of the content will be adopted from the second textbook, and infrequently from some other reference textbooks.

On-line resources

Lecture slides and lecture recordings, lab guidance videos, tutorial questions and solutions, lab manuals and all related MATLAB and Simulink files will be available on Moodle and MS Teams.

Recommended Resources

Reference books

- M. W. Spong, S. Hutchinson, and M. Vidyasagar, *Robot Modeling and Control*. Hoboken, NJ: John Wiley and Sons, 2006.
- F. Golnaraghi and B. Kuo, *Automatic Control Systems*. 10th edition, MaGraw Hill, 2017.
- G. F. Franklin, J. D. Powell and A. Emami-Naeini, *Feedback Control of Dynamic Systems*, Addison Wesley, latest edition.
- G.C. Goodwin, S. F. Graebe and M. E. Salgado, *Control System Design*, Prentice Hall, latest edition.

Course Evaluation and Development

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

As part of these evaluations, in Term 2 of 2019, the following new improvements were introduced:

- *There has been* ***a complete overhaul*** *of laboratory exercises. There are now total 6 completely redesigned lab experiments with increased focus on connecting theory to practical aspects of control systems.*
- *The lab guidance videos are integrated with the virtual lab tour allowing students to click on each piece of lab equipment to watch the related video and download/read relevant documents.*
- *Introduction of flipped tutorials for students to work on more challenging problems in a team-based learning mode.*
- *Newly designed weekly online quizzes as a method of ongoing feedback for students as they progress through the course.*

- *An optional project for students who want to learn more about the practical implementation of control systems.*

Due to COVID-19 in 2020, the entire in-person lab component has transitioned into a ***remotely accessed* format** developed by Dr. Arash Khatamianfar in collaboration with the professional staff of the School of EE&T and some top students.

- In this new delivery mode, all of the lab contents (which were completely redesigned in Term 2 2019) have been preserved, with new revisions to enhance the student learning experience.
- MS Teams is used to enable students get remote access to lab computers.
- The use of webcams allows students to access a live video feed of the equipment they are working with.
- The lab assessment structure is redesigned to better engage students with lab demonstrators and improve the learning and teaching experience in the lab by introducing reflective activities before and after the lab (the Pre-Lab and Post-Lab quizzes).
- The mid-term exam has been replaced with two assignments with more in-depth questions, enabling better assessment of student learning outcomes.

A new format of flipped tutorials will be trialed in this year which aims at better engaging students with problem solving and teamwork skills.

Academic Honesty and Plagiarism

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Academic Information

COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate**. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the Nucleus: Student Hub. If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for special consideration through the Special Consideration portal. To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this form.

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the Safe Return to Campus guide for students for more information on safe practices.

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/policy), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both formal classes and *independent, self-directed study*. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see https://student.unsw.edu.au/special-consideration.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

https://student.unsw.edu.au/guide

https://www.engineering.unsw.edu.au/electrical-engineering/resources

Disclaimer

This Course Outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies:

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	