UNSW SYDNEY

MTRN3500

Computing Applications in Mechatronics Systems

Term Three // 2020

School of Mechanical and Manufacturing Engineering // UNSW Engineering

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Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Jay Katupitiya	J.Katupitiya@unsw.edu.au		510E Ainsworth Building	9385 4096

Lecturers

Name	Email	Availability	Location	Phone
James Stevens	James.Stevens@unsw.edu.au			

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

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)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

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

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries

Course Details

Credit Points 6

Summary of the Course

The aim of this course is to implement software for vehicle simulation and control. The previously acquired C/C++ programming and control systems knowledge is used to develop user interfaces, simulations models and control algorithms for the control of vehicles including car-like robotic vehicles, tracked vehicles such as bulldozers and four-wheel-steer and four-wheel-drive vehicles. Kinematic and/or dynamic models of these vehicles will be used in developing simulation models. In addition, the course will also teach the interfacing of data acquisition systems, motion control systems, sensors such as inertial sensors, GPS sensors, laser sensors and encoders to facilitate sensing and actuation. The course has an extensive experimental content where the above developed software will be used to control either a tracked vehicle or a wheeled vehicle.

Course Aims

This course will help you learn how to put your programming skills into practice by dealing with some real world systems. As Mechatronics Engineers, we will inevitably have to deal with some real world systems, let them be robots, automated machines, autonomous vehicles and so on. As you can imagine, before you can bring a system under the control of your software you have to build a bridge to the machine which we call interfacing. Therefore, the first part of the course is on interfacing. For this you will be using and online accessible experimental rig equipped with a video stream which will allow you to see what is taking place at the experimental rig. After acquiring the interfacing skills and programming associated with it, in stage two, you will move on to take control of a real machine, in this case it will be an UGV. It will have a suite of sophisticated sensors, such as the GPS, laser range finders and possibly a reversing camera and then a motion controller that will facilitate its driving and steering. You will learn how to read these sensors, interpret the data and finally drive this around under the control of software you will develop. It is important to note that this course is not a programming course where programming will be taught, however, your programming skills will be tested in this course. The language you must use is C++. At the end of this course you will feel confident in developing software to control an automated system.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Be well versed with structured and modular programming using C/C and to have appreciated the use of software to communicate with external devices.	PE1.1
2. Be able to understand data structures, data transfer and transmission as well as inter-process communication.	PE1.1
3. Be able to develop full software packages that are usable with commercial grade Mechatronic systems.	PE2.3

Teaching Strategies

Teaching of this course is through web-based lectures and laboratory sessions. All laboratory work is individual work and laboratory set ups shold be accessed online. The majority of the laboratory work involves some form of hardware. Initially, the hardware is predominantly sensors and various kinds of interface devices such as analogue and digital input/output devices. Towards the end of the course, a fully developed physical system such as a UGV will be programmed and controlled.

The provision of the learning environment in the laboratory is to facilitate you to develop confidence in managing laboratory tasks as projects. The majority of the lab work involving actuators will be supervised by the demonstrators, professional officers and the academic in charge.

Additional Course Information

This course heavily relies on you prior programming knowledge and C/C++ knowledge. The standard pre-requisite is MTRN2500.

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Assignment 1: Object Oriented Interface Software Development	20%	The assessment of this assignment will take place during your scheduled laboratory class in week 5	1, 2, 3
Assignment 2: Writing software to control a ground vehicle.	20%	The assessment of assignment 2 is due in your routine laboratory session of Week 10.	1, 2, 3
Continuous assessment using weekly Minor Quizzes + the three parts of the Major Quiz..	60%	Minor quizzes close one hour before each lecture and Major quiz ending times will be announced in the Quizzes themselves in Moodle.	1, 2, 3

Assessment Details

Assessment 1: Assignment 1: Object Oriented Interface Software Development

Start date: 14/09/2020 06:00 PM

Length: Completely operational software source code.

Details:

Students will be given a description and skeletal software that they need to flesh out with complete C/C++ code to make the hardware interface fully operational.

Additional details:

Please see the Assignment 1 Specification for the marking guideline.

Submission notes: Submit unzipped Galil.h and Galil.cpp files

Turnitin setting: This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Assessment 2: Assignment 2: Writing software to control a ground vehicle.

Start date: Not Applicable

Details:

The students must develop software to control the car like vehicle in the laboratory and demonstrate its proper operation in the lab

Additional details:

Please refer to the assignment specification for the marking guidelines.

Submission notes: Submit the software you develop as a zip file.

Turnitin setting: This is not a Turnitin assignment

Assessment 3: Continuous assessment using weekly Minor Quizzes + the three parts of the Major Quiz..

Start date: Minor quizzes start 49 hours before lectures. Major Quiz Part 1 & 2 will start on Thursdays of weeks 4 and 7 at 6.00 pm. Major Quiz Part 3 will start at 3 pm of Monday of Week 10.

Details:

The 60 marks will be broken down into weekly Minor Quizzes and three parts of the Major Quizzes. The weekly quizzes will add up to 10 marks, Major Quiz - Part 1 is worth 13 marks, Major Quiz - Part 2 is worth 17 marks, and Major Quiz - Part 3 is worth 20 marks.

Additional details:

Marks for each question will be indicated in the quiz itself.

Submission notes: All quizzes are compulsory

Turnitin setting: This is not a Turnitin assignment

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
O Week: 8 September - 9 September		
Week 1: 14 September - 18 September	Lecture	C/C++ Refresher + Introduction to lab experiments
	Assessment	Minor quiz
Week 2: 21 September - 25 September	Lecture	Introduction to CLR based C++: Introduction to Common Language Runtime based programming
	Assessment	Minor Quiz
Week 3: 28 September - 2 October	Lecture	CPU, Peripherals and External Devices + Programming External Devices: Data flow, memory maps and programming external devices
	Assessment	Minor Quiz
Week 4: 5 October - 9 October	Screening	Programming Data Acquisition Systems: Programming of memory mapped data acquisition devices
	Assessment	Minor quiz
	Assessment	Major Quiz Part 1: Weeks 1 - 3 content will be tested.
Week 5: 12 October - 16 October	Lecture	Shared Memory and Inter-process Communication : Data exchange between independent modules
	Assessment	Minor quiz
	Assessment	Assessment of Assignment 1
Week 6: 19 October - 23 October		
Week 7: 26 October - 30 October	Lecture	Process Management: Managing multiple independent modules to operate concurrently
	Assessment	Minor Quiz
	Assessment	Major Quiz Part 2: Content from weeks 4-6 will be tested.
Week 8: 2 November - 6 November	Lecture	Ethernet Communication: TCP/IP date communication and ASCII data interpretation
	Assessment	Minor quiz
Week 9: 9 November - 13 November	Lecture	Serial Communication: Serial Communication and binary data interpretation
	Assessment	Minor quiz
Week 10: 16 November - 20 November	Screening	Development of a Flight Controller: Software for complex systems. No lecture but the students are

		required to watch the pre-recorded video.
	Assessment	Minor quiz
	Assessment	Major Quiz Part 3 : Content from Weeks 7, 8, 9 and week 10 pre-lecture videos will be tested.
	Assessment	Assessment of Assignment 2 : This will be done during your scheduled lab times. Please make an appointment with your demonstrator, in week 9.

Resources

Prescribed Resources

The students will have access to pre-lecture video content, lecture slides, sample programs, and hardware documentation.

Recommended Resources

Online resources of C/C++ programming.

Course Evaluation and Development

Students requested longer access to the hardware. This time, the hardware is make online avilable and the students can access the hardware 24 hours a day 7 days a week if the hardware is not used by another student.

Laboratory Workshop Information

While every student should work with the hardware, they can only be accessed online. Even under normal circumstances the student are not expected to tangible interact with this hardware. To facilitate visualization every student is provided with a camera image stream showing the activities taking place at the laboratory.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late policy

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the ‘deadline for absolute fail’ is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

1. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
2. Online quizzes where answers are released to students on completion, or
3. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
4. Pass/Fail assessment tasks.

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates. For further information on exams, please see the Exams webpage.

Special Consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your

assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW now has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID 19 illness or isolation** will be required in T3.

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Public distancing conditions must be followed for all T3 face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to other additional, **but limited**, number of on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

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. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where 1.5 metres physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism

Important Links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering
- Equitable Learning Services

Image Credit

This photograph was taken by Associate Professor Jay Katupitiya.

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	