School of Civil and Environmental Engineering

Term 2, 2021

CVEN4051
THESIS B (SAGE Stream)

COURSE DETAILS

Units of Credit	6	
Contact hours	4 hours per week	
Class	Monday, 12:00 – 14:00	John Goodsell LG19
Workshop	Monday, 14:00 – 16:00	CE611
Course Coordinator	Robert Holdom	
SAGE Stream Coordinator and Lecturer	Jinling Wang email: jinling.wang@unsw.edu.au office: CE413 phone: x54203	

INFORMATION ABOUT THE COURSE

This course is the second of two parts and is undertaken after the completion of CVEN4050 Thesis A, usually in the proceeding Term. The Thesis involves formulating the designs for and solution to open-ended civil and/or environmental, or **surveying and geospatial engineering** (SAGE) problems. The problems will be drawn from industry and will be multi-disciplinary involving application of material learnt throughout the undergraduate program and will require creative thought. The course will include the preparation of relevant professional documents. Part B involves the satisfactory preparation and submission an individual thesis addressing the well-justified project plan.

In Term 2, 2021, the Thesis B theme topic in the surveying and geospatial engineering stream will be: **"Smart Sensing and Geospatial Mapping for Engineering Applications**", while any suggested topics from students may also be considered. In Term 2, 2021, special measures should be taken to follow the Covid Safe rules in all the activities in this course.

HANDBOOK DESCRIPTION

See link to virtual handbook*:*

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/CVEN4051/

OBJECTIVES

The objectives of this course - Thesis B (SAGE stream) - are to broaden and deepen your knowledge and experience of modern geospatial data acquisition, positioning and mapping instrumentation, field methods, and 3D modelling and mapping software. In 2021, the Thesis B project activities are: a) to conduct your own studies on the emerging trend of using modern smart sensors for positioning and geospatial mapping and 3D modelling and mapping software platforms; b) to design field experiments for evaluation of the performance of smart sensors for positioning and mapping technologies for a variety of emerging digital twins for engineering applications.

The aim is to involve you in management aspects of field work, for positioning, 3D reality capture, and mapping as well as gaining more experience in measurement, fieldwork design, 3D geospatial data analysis, visualisation and to give you confidence in your ability to do positioning, 3D modelling, and mapping tasks of a type that you may not have done before at University or in employment. Students will be required to complete their work individually but partake in group discussions.

This course is a capstone course in your degree.

The objective of this course is to provide students the opportunity to complete a project task that they might be expected to complete in their professional employment from one of the key Civil Engineering and Surveying and Geospatial Engineering disciplines offered under Thesis B.

Linking the objectives with the program outcome attributes and the assessment strategies for this course:

Objectives	Program outcome attributes	Assessment
Broaden and deepen positioning, 3D modelling, mapping, and geospatial knowledge and experience	Undertake field data collections without detailed instructions	Quality of geospatial results. Quantity of geospatial mapping and 3D modelling results. Report
Management of fieldwork activities	Group work organised and lead by students.	Discussed and described in reports
Project Design	Design and plan the positioning and mapping project; 3D reality modelling and digital twins; Test the project design by implementation	Discussed and described in reports
Test and verification	Each student to test and verify the fieldwork and experimental procedures	Discussed and described in reports.

This course provides an environment that fosters in our students the following attributes as listed:

the skills involved in scholarly enquiry	
an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context	Significant
the capacity for analytical and critical thinking and for creative problem solving	Significant
the ability to engage in independent and reflective learning	Significant
the skills to locate, evaluate and use relevant information (Information Literacy)	Some
the capacity for enterprise, initiative and creativity	Significant
an appreciation of and respect for, diversity	Significant
a capacity to contribute to, and work within, the international community	Some
the skills required for collaborative and multidisciplinary work	Significant
an appreciation of, and a responsiveness to, change	
a respect for ethical practice and social responsibility	Some

More details on how the teaching and learning activities in this course are linked to each of these attributes will be discussed in classes.

TEACHING STRATEGIES

A major Thesis B Project theme topic will be given to the class each year and the student will be guided to establish the project activities in groups. For example, in 2021, the project theme topic is “Smart Sensing and Geospatial Mapping for Engineering Applications”, while any suggested topics from students may also be considered. Major project activities may include, such as, a) Positioning with smartphones, b) Building information modelling (BIM) with handheld laser scanners; and c) Geospatial mapping for construction automation; d) Ultra-Wide-Band (UWB) localization for construction site monitoring; e) Construction Digital Twins; f) Geospatial VR/AR/MR.

Once the project topics have been selected, the teams of students will be expected to work closely with the project supervisor, who will monitor progress, and give advice on what assessment tasks will be submitted.

Each group of students will work towards the overall design of the project activities and initial field work to test and improve the project design. Such group work will be submitted as a group report in Week 7 (5PM, Monday).

The staff will play the role of client and specify what tasks we want students to complete. Some technical details for special sensors (such as inertial sensors) will also be discussed in classes. We will not give extensive handouts describing in detail how to do the tasks. So the course is considerably different to other regular courses. However, staff will be available to give advice to students before, during and after the fieldwork.

Learning methods will be discussed at our class meetings and in the field. A significant aspect of this course is the group work and management by students. Part of the learning will include self-assessment because it is important that professional surveyors and engineers are able to assess their abilities and performance reliably.

A variety of teaching activities will be conducted to achieve optimal teaching and learning outcomes. Major teaching activities in this course are:

1) Regular lectures.
2) Workshop case studies.
3) Field work and experiments.
4) Class discussions.

The most important factors in learning are students' commitment and learning methods. You are encouraged to attend all the lectures and other teaching activities. In addition, relevant resources on the web (visit the course website for details) are of great help in understanding the basic concepts discussed in the lectures and the trends in the discipline of surveying and geospatial engineering, including modern positioning/mapping, navigation and timing technologies.

Based on some studies by a higher education research expert John Biggs, most active students in the class do not just listen, see, collect notes and take notes, but most importantly, they will *"express understanding; raise issues, speculate, solve problems, discuss, answer questions and reflect"*. Students are strongly encouraged to do sufficient preparation for class discussions on selected topics.

An example of the approaches to learning is:

Private Study	• Review lecture material and textbook • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • See methods that are not in the textbook • Hear announcements on course changes Find out what you must learn • Follow worked examples
Workshops	• Be guided by Lecturer/Demonstrator • Practice solving set problems • Ask questions
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Field Work	• Hands-on work, to test the project design, and to set studies in context [In Term 2, 2021, special measures should be taken to follow the social distancing rules in all the field activities in this course.]

EXPECTED LEARNING OUTCOMES

Thesis B aims to provide students with the opportunity to:

a) undertake and execute a practical research project.
b) produce a self-contained thesis report, which may be understood and used by others with technical background knowledge in the same discipline area as the thesis topic and may potentially be suitable for applications in practice.
c) present their practical research and experimental results in the class discussions.

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

By the end of this Term you should be able to

Learning Outcomes (LO)		EA Stage 1 Competencies
1.	*Describe the basic concepts of positioning, 3D modelling and mapping*	*PE1.1, PE1.2, PE1.6*
2.	*Explain what steps they would take to limit the introduction of errors;*	*PE1.2, PE1.3, PE1.4*
3.	*Master geodetic control design, geospatial mapping and verification steps;*	*PE1.5, PE2.1, PE2.3*
4.	*Explain the principles of major sensors used in smart sensors and their potential applications in 3D modelling and mapping; Digital Twins*	*PE1.6, PE2.2, PE3.3*
5.	*Appreciate the roles of precise GNSS positioning, smart inertial navigation sensors, and 3D mapping in mass market applications.*	*PE2.4, PE3.3, PE3.4*

At UNSW, Normal workload expectations for each program are a minimum of 25 hours per Term per unit of credit, including class contact hours, preparation and time spent on all assessable work.

For each hour of contact it is expected that you will put in at least 1.5 hours of self-centred and self-directed study: for example, reading the course related materials provided through the course website and reflect on the conceptual framework discussed in the classes.

COURSE PROGRAM

(The time slots for field work, data collection and experiments as well as any other changes will be notified in the class and at the course website).

Term 2, 2021

Week No.	Starting Date	Monday: 12:00pm-2:00pm Lecture Topics (Goodsell LG19)	Monday: 2:00pm-4:00pm Workshops (CE 611)	Assignment Due
1	31 May	Introduction on Thesis B (Objectives and Assessments) Positioning and Mapping concepts	Literature Search on smart sensing and geospatial mapping for Engineering Applications. Literature Review documentation	
2	7 June	Positioning, Navigation and Timing (PNT) concept Sensors on board smartphones: Sensor measurements	Thesis project statement and design. Smartphone GNSS/Low-cost RTK receivers: Raw measurement collection and analysis	
3	14 June	No Class (Public Holiday)	No Class (Public Holiday)	
4	21 June	Integration of GNSS and Inertial Measurements	Smart Inertial Sensors: Raw inertial measurement collection and analysis	Literature Review Report (Monday, 5pm)
5	28 June	Positioning vs Mapping; Building Information Modelling (BIM); Digital Twins;3D Point Cloud.	Thesis report structure. Smartphone images and analysis	
6	5 July	**Non-teaching week** for all courses	**Non-teaching week** for all courses	
7	12 July	Error analysis and quality control in positioning, 3D modelling and mapping	The time slot is rescheduled for fieldwork and data collection)	Group report on Thesis Project Design (Monday, 5pm)
8	19 July	The time slot is rescheduled for fieldwork and data collection	Field data processing and analysis	
9	26 July	The time slot is rescheduled for fieldwork and data collection	Field data processing and analysis	
10	2 August	**Class Discussion** Individual presentation on thesis project design, data analysis, conclusions, and recommendations	Field data processing and analysis	Thesis Presentation (Monday, 12pm)
11	9 August	Thesis Report writing	Thesis Report writing	Thesis Report Submission (Monday, 5pm)

ASSESSMENT

Assessment for this course includes:

Assessment Items	Length	Weight	Learning outcomes (LO) assessed	Due date*	Deadline for absolute fail*	Marks returned
Literature Review Report (Individual)	*8-10 pages*	*20%*	LO: 1, 4, 5	*Week 4*	Week 4 (5pm, Friday)	Week 4
Thesis Project Design Report (Group)	*15-20 pages*	*20%*	LO: 2, 4	*Week 7*	Week 7 (5pm, Friday)	Week 7
Class presentation (Individual)	10 mins	10%	LO: 3, 4, 5	Week 10	Week 10 (5pm, Mon.)	Week 11
Thesis Report Submission (Individual)	*30-40 pages*	*50%*	LO: 1, 2, 3, 4	*Week 11*	Week 11 (5pm, Friday)	Week 12

***Due date for the assessment item is the first class in the week specified in the above table.**

Literature Review Report (Individual) Assessment Criteria
Literature review is a critical part of any practical project design process. It is expected that the most significant areas of literature relevant to the proposed Thesis B project topic are reviewed, analysed and documented in a former manner to show the historical development, major contributions, current status as well as the future trends in the project topic areas. **The detailed marking scheme will be provided together with the Literature Review instructions in Week 1.**

Thesis Project Design Report (Group) Assessment Criteria
Each student will be in one of the groups of 4-5 students who will work collectively towards a selected broad project topic area which will cover the individual thesis projects to be worked upon by the students in the group). The group will: a) develop a statement on the practical investigation in the project and; b) design effective project activities to achieve the objectives of the project; c) Test the project design, d) prepare a thesis project design report as a group. Further information about the *Thesis Project Design Report* will be distributed during the lectures. The group report (20%) will be assessed in terms of: a) Written presentation (2%); b) Project statement and design (5%); c) Measures to follow the social distancing rules in field work 3%; d) Field notes and computations (5%); e) In-depth discussions on relevant issues (5%).

Class Discussion Presentations and Assessment Criteria
Students should regularly attend the lectures and participate actively in class discussions during the lectures. The students are invited to give a former thesis presentation to the **class discussion in Week 10**. These thesis presentations will offer the opportunities for students, a) to demonstrate and enhance their understanding of the concepts and design covered in the thesis project; b) to establish links between the concepts and real world applications of the project design, c) to develop technical presentation skills. **The detailed marking scheme will be provided together with the class discussion instructions in Week 6.**

Thesis Report Submission (Individual) *Assessment Criteria*
Each student will work independently on some aspects of the project designed by the group to further refine the project design and test and verify the various aspects of the conceptual design towards the project objectives. Final individual report Thesis B (50%) will be assessed based on the following criteria: a) Written presentation (5%); b) Review of other work (5%); c) Quality of thesis project work (10%); d) Workflows, results and Analysis (15%); e) Conclusions and recommendations (10%); f) Documenting and archiving the full project field notes and data sets 5%.

Note:

1) If a student is unable to submit on time due to illness or other legitimate reason, then a brief written explanation must be given to the lecturer for consideration as soon as is feasible and the student must formally apply for Special Consideration. Otherwise, the marks for late submissions will be reduced: -10% (of the maximum mark) for each day late.
2) The course coordinator reserves the right to adjust the final marks by scaling if agreed to by the Head of School.
3) No Final Exam/Supplementary Examinations for this course.

RELEVANT RESOURCES

- Materials from previous GMAT courses that you have studied.
- Additional materials provided on Moodle.
- Survey equipment from our store CE G7.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

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

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

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

All assignments and assessment items should be submitted with a signed Assessment Cover Sheet:

I declare that this assessment item is my own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:

Reproduce this assessment item and provide a copy to another member of the University; and/or,

Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.

Signed: .....date: ☐☐ ☐☐ ☐☐

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Academic Advice on the School website available at:
https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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