School of Civil and Environmental Engineering

Summer Semester, 2017 - 2018

CVEN4310 DEFORMATION MONITORING SURVEYS

COURSE DETAILS

Contact hours	2 days per week for 5 weeks	
Classes	Wednesday, 9 am – 5 pm	Room: CE101 or CE201 or field
	Thursday, 9 am – 5 pm	Room: CE101 or CE201 or field
Course Coordinator and Teacher	Dr Bruce Harvey email: B.Harvey@unsw.edu.au office: CE207 phone: 9385 4178	

COURSE PROGRAM SUMMER, 2018

Students in group A attend Lab A and Field A. Students in group B attend Lab B and Field B. Both groups attend all lectures. Field classes meet at Survey Store CE G7 unless advised otherwise.

Wk	Day / date / time	Room	Lecture topic
1	27 Nov 2017 -		No class
2	4 Dec -		No class
3	11 Dec -		No class
	recess		18 Dec 2017 – 1 Jan 2018
4	**Wed** 3 Jan 10am-12	CE101	Course overview, intro & organisation. Revision of basic surveying. Project Surveying Methodology.
	3 Jan 1-2pm	CE101	Principles and concepts of deformation monitoring by surveying techniques
	3 Jan 2-3pm	CE101	Control survey network adjustments and simulations
4	**Thu** 4 Jan 9-12	CE201	Lab A: Least Squares Calculations and total station observations
	4 Jan 12:30 – 1:30	CE101	Terrestrial Laser scanning, for high definition surveys pt1
	4 Jan 2-5pm	CE201	Lab B: Least Squares Calculations and total station observations
5	**Wed** 10 Jan 9-12		Field A: Measure the deformation (≈5mm) of a small bridge on campus by digital levelling and by total station and by RTKGPS
	10 Jan 12:30 – 1:30	CE101	Terrestrial Laser scanning, for high definition surveys pt2
	10 Jan 2-5pm		Field B: Measure the deformation (≈5mm) of a small bridge on campus by digital levelling and by total station and by RTKGPS
5	**Thu** 11 Jan 10-11am	CE101	Underground Mine and Tunnel surveys. Open cut mines, wall monitoring.
	11 Jan 11-12	CE101	GPS for high frequency bridge monitoring. (Guest lecturer)
	11 Jan 12-1	CE101	Monitoring high rise buildings. Tiltmeters.
	11 Jan 2-4pm		Field A: Use ATR motorised total station for High Precision survey.

6	**Wed** 17 Jan 9-11am		Field B: Use ATR motorised total station for High Precision survey.
	17 Jan 11-12	CE101	Subsidence monitoring above underground mines by levelling and by INSAR. (Guest lecturer)
	17 Jan 1-2	CE101	Motorised TS instruments & automatic target recognition for dam and wall monitoring.
	17 Jan 2-4pm	CE101	Dam Deformation surveys (Guest lecturer)
6	**Thu** 18 Jan 9-11	**TBA**	**Mid course test**
	18 Jan 11-12	CE101	Student seminar presentations based on a journal articles relevant to this course.
	18 Jan 1-2pm	CE101	High Precision survey techniques. 3D theodolite intersection systems. Laser trackers.
	18 Jan 2-5pm	CE201	Lab A: Problem solving case studies: Bridge, wall, radio telescope surveys.
7	**Wed** 24 Jan 9-12	CE201	Lab B: Problem solving case studies: Bridge, wall, radio telescope surveys.
	24 Jan 1 - 3	CE101	Deformation Monitoring Case Studies. (Guest)
	24 Jan 3 - 4	CE101	Close Range Photogrammetry, for monitoring scale models, building facades and heritage bridges
7	**Thu** 25 Jan 9-12	CE201	Lab A: Design monitoring network - field and lab work
	25 Jan 1-4pm	CE201	Lab B: Design monitoring network - field and lab work
8	**Wed** 31 Jan 9-10:30	CE101	Atmospheric Refraction, effects and how to deal with it
	31 Jan 10:30- 11	CE201	Lab A: calculations
	31 Jan 11 – 11:30	CE201	Lab B: calculations
	31 Jan 1-2	CE101	Survey network adjustments: datums, free networks, deformation analysis
8	**Thu** 1 Feb 9-11 am	CE201	Lab A: Analysis of Bridge deformation survey data
	1 Feb 11-12	CE101	Interactive summary of course
	1 Feb 1-3 pm	CE201	Lab B: Analysis of Bridge deformation survey data
			Final Exam In Feb exam period, date determined by UNSW exams branch

INFORMATION ABOUT THE COURSE

This is an elective course that assumes students have completed one previous surveying course, GMAT 1110 or equivalent. It is intended for Civil or Mining Engineering students near the end of their undergraduate degree. This is not a distance education course. Students are expected to regularly attend classes on Wednesdays and Thursdays in weeks 4 to 8 inclusive. Selected topics of specialist survey applications will be dealt with using lectures, guest speakers and use of surveying technology.

Aim of the Course

To broaden and deepen the knowledge of deformation monitoring surveys, including a broad range of survey instrumentation and analysis techniques relevant to engineering and industry. The aim of this course is to cover several topics and methods that are specialist skills of a consultant surveyor, not common place skills. But it does **not** aim to give students a vast knowledge of all the topics. We do not expect that every civil or mining engineering graduate will need to know all of the particular topics covered or necessarily work in these topics in the future. However, some graduates will need to know some of the topic areas in great

detail and may spend a considerable part of their career in one of the fields introduced in this course. Moreover, even if you don't work in the specific topic areas of this year's course, the educational process and underlying knowledge may valuably be applied to other surveys.

Learning Outcomes
By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for surveys, and be familiar with the analysis aspects of deformation surveys including datum and free net problems. You will understand the strengths and characteristics of several different survey techniques and be able to decide which technique to use for different deformation monitoring problems.

HANDBOOK DESCRIPTION

See link to virtual handbook: www.handbook.unsw.edu.au/undergraduate/courses/2017/CVEN4310.html

This course introduces the concepts, principles and techniques used for deformation monitoring to civil engineering students with an interest in structures or geotechnical. Topics include: Principles and concepts of deformation monitoring by surveying techniques. Project surveying methodology. Control survey network adjustments and simulations. Atmospheric effects on optical and radar measurements. Terrestrial Laser scanning. Underground mine and tunnel surveys. Open cut mines, wall monitoring. Subsidence monitoring above underground mines. Monitoring high rise buildings. Tiltmeters and GPS for high frequency bridge monitoring. Motorised total station instruments and automatic target recognition for dam and wall monitoring. High precision (sub-mm) survey techniques. 3D theodolite intersection measuring systems. Laser trackers. Dam deformation surveys. Close Range Photogrammetry, for monitoring scale models, building facades and heritage structures.

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The formal exam scripts will not be returned, but students may discuss them individually with the course coordinator to assist with feedback. Standard UNSW grades (e.g. HD, DN, CR, PS, FL). Students can get more information on assessment content, criteria, and mode via class discussions or discussions with the course convenor.

Assessment for the course includes:

Name	Mark	Due
• Mid-session test	30%	Thursday Week 6
• Assignments: Seminar presentation	6%	Tuesday Week 6
• Problem Based Learning	19%	End of each lab or field class
• Final Exam	45%	In formal exam period

	Assessment Title	Assessment Type	Weight (%)
1	Mid-session test	Test	30%
	Assessment description and feedback process:	Conventional test. Individual feedback is given by the lecturer. Small class.	
2	Assignment	Report and seminar	6%
	Assessment description and feedback process:	This assignment requires study of an international survey conference paper (eg FIG or IAG) or journal or survey project reports in a technical publication. Students select one of the papers that relates to the topics in CVEN4310. No two students use the same material. Each student prepares a 5 minute Powerpoint or similar presentation. The presentation should be a clear and concise summary of the base material and reveal an understanding of the topic. The top 10 students present their submission on Thu week 6 for higher marks (D &HD) the non-presenters earn F, P, or CR. Students who give presentations are informally given feedback by the peers.	

3	Final Exam	Examination	45%
	Assessment description and feedback process:	Final exam supervised by UNSW exams branch. Students are invited to visit the lecturer after the examination period for individual feedback.	
4	Problem Based Learning	Field work and computer lab exercises	19%
	Assessment description and feedback process:	There are several field work and computer lab exercises that are to be submitted at the end of each session. Students who perform poorly in these tasks are recommended to discuss progress with the lecturer during the semester.	
Total Weight			**100%**

Assessment items and their relationship to Course Learning Outcomes:

1. Mid-session test

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for surveys; and be competent with the analysis aspects of deformation surveys.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.

2. Assignment Seminar

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for surveys; and be competent with the analysis aspects of deformation surveys.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.
- Ability to design and execute Surveying & Geospatial measurement and data analysis for surveying projects.
- Commitment to lifelong learning and continuing professional development.

3. Final Exam

- By the end of this course you will be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for surveys; and be competent with the analysis aspects of deformation surveys.
- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.
- Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.

4. Problem Based Learning

- In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.

Further information:

Any changes to the above assessment details will be notified in class and on the class Moodle site. Further details of assessment and exam rooms will be given in classes, if in doubt contact the lecturer.

The midsession test will examine topics covered in the first 2 weeks of the course (weeks 4 and 5). The final

exam will concentrate on the topics in weeks 6 to 8, but will also require some application of knowledge covered in the first six weeks.

There might be some calculation based questions in the exams but most of the questions will seek to find whether you have learned some of the main facts and information, whether you understand the important aspects of the type of surveying covered in the question, and whether you can describe how you would apply the knowledge.

Some of the questions in the tests will require you to propose a solution for a non-routine survey problem that a new client might bring to you as a consultant. The highest marks will go to those who can propose a good method, justify it well, and communicate their proposed solution to a client clearly and reliably. Pass marks will go to those who can present a reasonable problem solution and a reasonable justification for their proposal. Note that some questions in the assessment tasks in this course have more than one correct answer and different surveyors might propose a variety of valid solutions. In such cases your answers should include justifications for your methods, you do not need to try to find or guess what the examiners own personal opinion or solution might be.

Further details will be given, and discussed in class, about the type of questions that might be in the exams and which parts (topics and expected outcomes) of the course are related to the exam. The exams are set by the course convenor and reviewed by another staff member of the school.

Seminar Assignment requires study of an international survey conference presentation (e.g. FIG or IAG) or journal or survey project reports in a technical publication as published by e.g. Leica or Trimble. For theis assignment students are to select one of the FIG presentations that relates to the topics in CVEN4310. Students should then advise the lecturer of their selection so that no two students use the same material, so get the lecturer's approval before starting work on the assignment. Each student will make a 5 minute PowerPoint (or similar) presentation. No other report needs to be submitted but the presentation should be a clear and concise summary of the base material and reveal an understanding of the topic. Source material is available from the lecturer. Further details of the assignment will be given during session.

Rules for practical / field classes

This course involves a small amount of field work. If there is light rain field work is on, if rain is heavy then the practical might be postponed. Do not assume a class will be cancelled, attend on time and ask the supervisor. Practical classes take place in a variety of weather. Do not forget umbrellas, water proof jackets, hats, sun cream, sturdy footwear (thongs or sandals are not acceptable), warm clothes, etc.

The practical exercises form an important part of the subject. A good deal of time and care has gone into the organisation of these classes to ensure that you get the maximum benefit from the time that you spend and the equipment which is available. Most practicals will be done in groups of students. It is important that each student within a group gets experience in each aspect of each practical.

The location of fieldwork will depend on the state of construction on campus. Supervisors will advise you of the site and H&S matters. If you have any questions or doubts about an H&S matter discuss it with you supervisor. Students are required to read the supplied instructions well before the exercise is commenced. ***Any equipment lost or damaged will have to be paid for by the group.***

TEACHING STRATEGIES

This course is currently taught by UNSW academic Bruce Harvey and industry experts as guest lecturers if they are available. Emphasis is placed on problem solving skills and application to real case studies from consulting surveying. The lectures give an overview of problems and methods, but not all the details. The lecturers ask questions during the lecture periods that stimulate thought into the topics. The aim is to involve students in the class, to deepen their understanding of the topics, and to give them confidence in their ability to design and undertake high precision, or unusual consulting surveys.

We will attempt to ECHO record many of the lectures. These are not intended to be a substitute for class attendance but may be useful for students who can't avoid missing a class and for those who attend the

class but want to rehear part of it to aid their understanding. Of course such files are copyright and are not to be distributed beyond the enrolled students in the class.

Previous students' feedback in the annual CATEI/myExperience surveys rated this course taught very highly.

Suggested Learning Methods

Attendance and attention at lectures is strongly recommended. *At UNSW, the normal workload expectations of a student are about 150 hours for a 6 UoC course, including class contact hours, exam study preparation and time spent on all assessable work.*

OBJECTIVES

To broaden and deepen the knowledge of surveying instrumentation, to discuss equipment used in related areas of measurement and to introduce students to specialised surveying techniques relevant to engineering and industry. A broad range of Survey instrumentation other than GPS and photogrammetry will be covered in this course; the latter two topics are covered in other courses.

The aim of this subject is to cover several topics and methods that are specialist skills of a consultant surveyor, not common place skills. But it does **not** aim to give you a vast knowledge of all them. We do not expect that every graduate will need to know all of the particular topics covered or necessarily work in these topics in the future. However, some graduates will need to know some of the topic areas in great detail and may spend a considerable part of their career in one of the fields introduced in this course. Moreover, even if you don't work in the specific topic areas of this year's course, the educational process and underlying knowledge may valuably be applied to other surveys.

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

the skills involved in scholarly enquiry	Significant – a vast quantity of material and reference matter to be studied and reflected on in the portfolio
an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context	Significant, this is probably the main attribute for this course
the capacity for analytical and critical thinking and for creative problem solving	Significant – applying surveying technologies and methods creatively to particular specific case problems
the ability to engage in independent and reflective learning	Some – as per the portfolio assignment
the skills to locate, evaluate and use relevant information (Information Literacy)	Some
the capacity for enterprise, initiative and creativity	Significant – designing creative survey solutions to problems
an appreciation of and respect for, diversity	
a capacity to contribute to, and work within, the international community	
the skills required for collaborative and multidisciplinary work	Some – group field work
an appreciation of, and a responsiveness to, change	Some – applying new methods and new technology creatively, not just reading text books for solutions to problems
a respect for ethical practice and social responsibility	Some – considering the consequences of our surveys
the skills of effective communication	Significant – group field work, and seminar presentation

EXPECTED LEARNING OUTCOMES

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

Learning Outcome		EA Stage 1 Competencies
1.	Be familiar with the problems and methods of survey and be competent in designing survey methods including choice of instruments, analysis and error prevention for surveys; and be competent with the analysis aspects of deformation surveys.	*PE1.1, PE1.2, PE1.3, PE1.5*
2.	In-depth technical competence in Surveying & Geospatial technologies, methodologies and practice.	*PE1.1, PE1.2, PE1.3, PE2.2*
3.	Ability to carry out problem identification, and the design of the solution with the level of creativity and innovation appropriate to the complexity of the challenge.	*PE1.3, PE1.5, PE2.1, PE2.3*
4.	Ability to design and execute Surveying & Geospatial measurement and data analysis for surveying projects.	*PE1.3, PE1.5, PE2.2, PE2.3, PE2.4, PE3.4*
5.	Ability to function effectively as an individual and in multicultural teams, as a team leader or manager as well as an effective team member.	*PE3.2, PE3.6*
6.	Commitment to lifelong learning and continuing professional development.	*PE3.1, PE3.5*

PENALTIES

Late work will be penalised at the rate of 10% per day after the due time and date have expired.

RELEVANT RESOURCES

- There is no text book.
- The PowerPoint lecture slides are available for download as pdf files the course Moodle website: Monitor the site during session because it will be updated regularly. Additional materials also provided on Moodle.
- This course has a lot of reading material available on the class web site and elsewhere. You are advised to find some of the material that interests you the most and study it, for the other material skim through it at a level that you know what is there and where to find it if you need it later. The objectives of this course are to introduce you to several different types of specialist consulting surveying, not to make you an expert in all the topics. So the assessment tasks will NOT seek to find if you have read and memorised it all. The assessment tasks will seek to find if you have read some of the material and studied (by reflection) some of the topics in some depth.

Reference Books

The relative importance of class notes and reference books, and purchase details will be discussed in class.

BANNISTER, A., Raymond, S. Baker, R. (1992) Surveying, 6th Edition, Pitman, London.

CASPARY W (2000) *Concepts of Network and Deformation Analysis*, Monograph No. 11, 3rd impression, School of Geomatic Engineering, UNSW

HARVEY BR (2016) *Practical Least Squares and Statistics for Surveyors*, Monograph No. 13, 3rd ed., UNSW.

HARVEY B.R. (2016) Surveying Computations. Free pdf on the class Moodle website

KAVANAGH, B.F. (2003) Surveying: Principles and Applications, 6th Ed, Prentice Hall, ISBN 0-13-099582-7

OGAJA CA (2011) *Geomatics Engineering: a practical guide to project design*. CRC Press ISBN 978-1-4398-1743-8

RÜEGER JM (2003) Electronic *Surveying Instruments* Monograph 18, School of Surveying and Spatial Information Systems, UNSW A free copy will be supplied to all students in this course in 2015.

RÜEGER JM (1996) *Project Surveying*, Lecture Notes, Papers, Tutorials and other Material School of Geomatic Engineering, UNSW, Jan 2001, 332 + x pages Out of print but new versions of parts of it are on class web site.

RÜEGER JM (1996) *Electronic Distance Measurement - An Introduction*, 4th ed., Springer-Verlag, Berlin-Heidelberg-New York, http://www.springer.com/earth+sciences+and+geography/geophysics/book/978-3-540-61159-2

SCHOFIELD, W. & Breach, M. (2007) "Engineering Surveying", 6th edition.Elsevier.
URENJ and PRICE WF *Surveying for Engineers, 6th Edition or later*
VOSSELMAN G and MAAS H-G (2010) *Airborne and Terrestrial Laser Scanning* Whittles ISBN 978-1904445-87-6

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://my.unsw.edu.au/student/resources/KeyDates.html

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 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,
- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC and SURVSOC

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