School of Civil and Environmental Engineering

Term 3, 2021

CVEN3702 SOLID WASTE AND CONTAMINANT TRANSPORT

COURSE DETAILS

Units of Credit	6	
Contact hours	6 hours per week	
Class	Tuesday, 9:00 – 11:00	Online
	Thursday, 14:00 – 16:00	Online
Workshop	Tuesday, 11:00 – 12:00	Online
	Thursday, 16:00 – 17:00	Online
Course Coordinator and Lecturer	Prof Denis O'Carroll (DOC) email: d.ocarroll@unsw.edu.au	
Demonstrators	Diana Ackerman Grunfeld Email: d.ackermangrunfeld@student.unsw.edu.au	

INFORMATION ABOUT THE COURSE

Courses undertaken prior to CVEN3702 provide support for the content in CVEN3702 in the following areas:

- BIOS1301, CHEM1011, and CVEN2701 provide the biochemistry and chemistry to understand anaerobic digestion of organics in landfills, aerobic treatment of organics in composting, and partitioning of substances through physical, biological and chemical processes used in waste processing facilities.

- CVEN1701 enables students to take the components of waste management systems introduced in the course, and combine them in optimal ways to achieve the overall aims of regional waste management systems; it also introduces material accounting techniques of Life Cycle Assessment and Material Flux Analysis that can be used to analyse the environmental impact of waste processes, and be can used to optimize the design of facilities and waste management systems at corporate and regional level

- CEIC2009 is one of the most important preparatory courses, enabling students to undertake mass balances of goods and substances through waste processes such as material recovery facilities and waste incinerators.

- CVEN2501 includes the fundamental principles of fluid flow (viz continuity, energy and momentum) in pipes (closed conduits) and open channels (free surface flows). These principles are based on the balances of influxes and effluxes of mass, energy and momentum associated with control volumes.

- CVEN3701 describes the international, national and NSW laws governing waste management; and outlines EISs and EMSs that can be applied to waste facilities.

After completing CVEN3702, the following courses complement and supplement content in CVEN3702:

- CVEN4701 enable the development of waste management systems at a regional level; components of regional waste systems not included in this course, may be covered here.
- CVEN9881 extends the course into the area of hazardous waste management; it is generally offered in alternate years.

HANDBOOK DESCRIPTION

An introduction to waste management systems, from generation to treatment and disposal; may include waste characterisation, waste minimisation, transfer stations, recycling facilities, composting waste to energy and landfill waste disposal. Contamination of receiving environments from poor waste disposal, including pollutant sources, spreading of contaminants in air and water, transport processes in the environment.

Link to virtual handbook:

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/CVEN3702

OBJECTIVES

In the **Solid Waste** component, the objectives of this course are to:

- Provide an appreciation of the management of solid waste in a systems context; ie to understand the nature of the various functional elements in regional waste management systems and the relationships among them, so that optimal systems can be designed.

- Provide an understanding of the characteristics of urban solid waste, and be able to estimate the composition and quantities for any region.

- Be able to understand the data requirements for, and then be able to prepare concept designs of, common functional elements (such as transfer stations, material recovery facilities, landfills, treatment plants) in solid waste management systems.

In the **Contaminant Transport** component, the objectives are to:

- Provide an understanding of the fundamental processes of tracer or pollutant movement in the biosphere. Specifically, this will include receiving waters and the atmosphere.

- Provide you with the skills to enable you to apply theory to solve problems and make estimates of pollution levels in the environment.

HOW DO ASESSMENT STRATEGIES ASSIST IN ACHIEVING THESE OBJECTIVES, AND HOW DO THE OBJECTIVES CONTRIBUTE TO ACHIEVEMENT OF PROGRAM OUTCOME ATTRIBUTES

Contaminant transport component:

The capacity for analytical and critical thinking and for creative problem solving: You will be exposed to, and be required to solve, numerous and varied problems in the Lectures, the Exercises and the assignments - “the learning is in the doing”. All these problems will cover a variety of scenarios, and where possible, will be

drawn from engineering practice. You will be furnished with the Exercise solutions to all problems on Moodle so that you are able to check your analyses.

Solid Waste component:

The assignment will make up 20 of the 50 marks for the assessment for this component of the course, and you are required to work in a small group (of up to 3) for the Assignment. Refer to Moodle for group self-selection procedure. Briefing and data provision will be similar to that available in real world situations, and you will need to make professional judgments to be able to prepare reasonable designs that have the ability to be developed by other engineers, such as geotechnical, structural, process, mechanical, electrical engineers, so that a working facility can be implemented. The lecturer will take the role of a Principal Engineer in a consulting office and will assist student groups in exercises and via Moodle discussion forum. Overall project management skills requiring coordination within the group is required in the preparation of the assignment reports. These skills have been learned in previous courses and you need to practice and demonstrate your acquisition of them in this course.

In general terms, all waste assignments will be assessed against the following general criteria, to encourage the achievement of the objectives:

- Evidence of understanding of concepts; exact correct numerical answers will rarely be required or be appropriate, but gross numerical errors which are left unchecked, and which indicate that the student does not understand the concepts, will be marked down heavily.
- Ability to apply concepts to real world problems, and to make judgments based on incomplete data and the need to simplify systems in order to develop solutions.
- Clarity of description, explanation and attention to the focus of the assignment.
- Ability to structure an assignment logically and limit it to a reasonable length.

The course objectives, content and assessment concentrate on encouraging the development of the following attributes in students, with particular application to Waste Management as described:

- *An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context:* the influence of socio-economic circumstances on waste generation will need to be included in waste generation predictions, and in the commentary on the implementation stages of waste facility establishment, in the design of one of the facilities in a region.
- *The capacity for analytical and critical thinking and for creative problem solving:* Data will be incomplete, and an analysis of the fundamental influences on waste generation will need to be made to arrive at reasonable projections; then creative designs for facilities to suit the circumstances of the hypothetical region will need to be produced in the second assignment.
- *The ability to engage in independent and reflective learning:* lectures will give standard procedures for the design of waste facilities such as landfills and waste sorting facilities; you will then need to independently develop appropriate solutions for the hypothetical region, and draw on the Principal Engineer (lecturer) for reactive advice after you have developed and reflected on their own designs – the Principal Engineer will not do creative design work for you.
- *Information literacy:* you will need to find appropriate web sites, and use suggested texts and journals to find supplementary information to enable them to go into sufficient detail to produce workable concept designs for facilities – all details will not be given in lectures. **You must not directly contact by any means, private or public organisations. This can only be done by the Principal Engineer (lecturer).**
- *The skills for collaborative and multi-disciplinary work:* you will work in group of up to 3 and will need to manage their time and inputs to meet deadlines; the inputs of other disciplines that would need to be included in real world situations will need to be recognized and commented upon. All students in

each group get the same assignment marks.

In general, both components of the course aim to facilitate:

- *A respect for ethical practice and social responsibility:* you will need to conduct the preparation and submission of their assignment projects in accordance with UNSW policies on academic conduct as detailed at:
  http://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

  and in accordance with the IEAust's code of ethics as at (search code of ethics there):
  http://www.engineersaustralia.org.au

- *The skills of effective communication:* in this course, memo's and technical reports need to be appropriate for a technical audience in Councils and consulting engineers. They are not novels. They are technical reports, typically using an introductory sentence and point form, and provided with at least 2 levels of numbered headings. Harvard referencing system must be used.

TEACHING STRATEGIES

Solid Waste Component:

Lectures will provide an explanation of procedures to follow to quantify waste generation in a region, and then to prepare conceptual designs of waste management facilities, particularly in the urban solid waste area. Examples will be given in these lectures. You then need to learn these procedures by characterizing waste generation in a region, and preparing conceptual designs for selected waste facilities to a standard typical in a consulting office.

All material will be provided on Moodle. Printed and photocopied notes, overheads etc. will not be provided.

The approaches to learning are:

Private Study	• Review lecture material, reference books, pdf's on eLearning MOODLE. • Do set problems and assignments. • Reflect on class problems and assignments.
Lectures	• Take notes on skeleton .ppt overheads provided to get a full set of reference notes for the course; using "Normal" or "Notes Page" view. • Learn methods of design of waste facilities that are not well documented in reference books. • Participate in working out example problems in class.
Exercises	• Work actively on problems set in class and Exercises. • Ask questions on assignment problems.
Assessment	• Formative and summative assessment of knowledge and skills in assignments, with students encouraged to seek formative informal assessment via consultation with the Principal Engineer/lecturer during preparation of assignments. • Demonstrate higher understanding and problem solving on real world problems in a hypothetical region/context. • Exams are summative assessments on knowledge gained in the course, particularly as indicated by the ability to quickly undertake exercises set in the Exercise problems.
Site visit (to be	• Hands on work to set studies in context, to see operating problems with facilities in Sydney, with the aim of improving the conceptual design of waste

confirmed)	facilities when you are a practicing engineer.
Email	• You are strongly advised to check your UNSW emails daily for course related messages that are sent via News forum in Moodle. Use Q&A in Moodle to ask questions, as this builds an archive for all students in the course.
MOODLE	• The Waste Management and Contaminant Transport Lecture Notes can be found on MOODLE. • From time to time, other information will be placed on MOODLE. This may include notes on assignments and the data section of the final exam.

EXPECTED LEARNING OUTCOMES

Solid Waste component:

- Describe a regional urban solid waste management system, showing the flow of goods between processes and being able to calculate material balances throughout the system.
- Characterise the waste generation in a region and make predictions.
- Prepare concept designs of some of the following waste facilities:
    - Transfer stations
    - Waste to energy facilities
    - Material recovery facilities
    - Landfills

Contaminant Transport component:

- Explain the fundamental principles, and their limitations, of pollutant movement in receiving waters.
- Assess pollutant levels by carrying out computations of pollutant movement.
- Have an understanding into the mechanisms responsible for pollutant movement which will enable you to design and undertake investigations, be they in the field and/or by applying the appropriate software packages.
- Be able to carry out self checks on your estimates for pollution levels from simple models or calculations.

Learning Outcome		**EA Stage 1 Competencies**
1.	*Apply the design concepts to design a waste management strategy.*	*PE1.1, PE1.5, PE2.3*
2.	*Apply the best use of contaminant transport conceptual models to predict the movement of contaminants in the environment.*	*PE1.2, PE2.2, PE2.3*
3.	*Create a concept of waste flow from a municipal source to ultimate disposal.*	*PE1.2, PE2.2, PE2.3*
4.	*By the conclusion of this course the student will be able to develop knowledge and skills understanding how contaminants move through the environment.*	*PE2.2, PE2.3, PE3.3*

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

COURSE PROGRAM

Term 3 2021

Date	Topic	Lecture Content	Demonstration Content
13/09/2020 (Week 1)	Introduction	Introduction and background	Introduction, and background, demo structures (and Assignments 1 and 2)
20/09/2020 (Week 2)	Waste minimisation, characterization	Waste minimisation and recovery, Waste characterization	Waste minimisation and Waste characterization
27/09/2020 (Week 3)	Waste transfer, Composting	Waste collection and transfer, Composting and MBT	Waste transfer, composting
04/10/2020 (Week 4)	Landfill waste (guest lecturer – Dr. Stuart Dever - Kimbriki Resource Recovery Centre), waste to energy	landfill waste disposal, waste to energy	MBT and waste to energy
11/10/2020 (Week 5)	Landfill gas and leachate management (guest lecturer – Dr. Stuart Dever-Kimbriki Resource Recovery Centre)	landfill gas, Landfill leachate and leachate management,	landfill waste disposal & landfill gas, landfill leachate
18/10/2020 (Week 6)	Flexibility week for all courses (non-teaching)		
25/10/2020 (Week 7)	Processes of contaminant transport (guest lecturer – Dr. David Reynolds – Geosyntec Consultants)	Processes of transport, diffusion and decay (2hrs) Dispersion in laminar and turbulent flows (1hr) Guest Lecture from Dr. David Reynolds from Geosyntec (1hr)	Processes of transport, diffusion and decay Dispersion in laminar and turbulent flows
01/11/2020 (Week 8)	Jets, plumes and buoyant jets	Jets, plumes and buoyant jets	Jets, plumes and buoyant jets
08/11/2020 (Week 9)	Estuaries	Estuaries: classification and circulation	Estuaries: classification and circulation
15/11/2020 (Week 10)	Atmospheric dispersion	Atmospheric dispersion	Atmospheric dispersion

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The Final Examination is worth 60% of the Final Mark if class work is included and 100% if class work is not included. The class work is worth 40% of the Final Mark if included. *A mark of at least 40% in the final*

examination is required before the class work (assignments) is included in the final mark. The formal exam scripts will not be returned but you are permitted to view the marked script.

Students who perform poorly in the workshops are recommended to discuss progress with the lecturer during the term. Note: The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

Supplementary Examinations for Term 3 2021 will be held on Monday 10th January to Friday 14th January 2022 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

PENALTIES

Penalties for late submissions should also be included here. For example, late work will be penalised at the rate of 10% per day after the due time and date have expired.

ASSESSMENT OVERVIEW

Item	**Length**	**Weighting**	**Learning outcomes assessed**	**Assessment Criteria** *(this needs to explicitly describe what students are expected to demonstrate in the task)*	**Due date and submission requirements**	**Deadline for absolute fail**	**Marks returned**
Assignment 1 Section (1)	Take Home	10	Conceptual design of a landfill	Assess the understanding of the concepts, data collection, calculations and reporting. Section 1 is the data gathering and calculations Will be explained in detail during demonstration	Section 1 Due date: Sunday 3rd of Oct (11:59pm)	Section 1 Due date: Tuesday 5th of Oct	Friday 8th of Oct
Assignment 1 Section (2)	Take home	10	Conceptual design of a landfill	Assess the understanding of the concepts, data collection, calculations and reporting. Will be explained in detail during demonstration	Section 2 Due date: Sunday 17th Oct (11:59pm)	Sunday 24th of Oct	Tuesday 2nd of Nov
Assessments							
Assignment 2	Take home	20	Processes of contaminant transport. Dispersion and Diffusion. Jets, plumes and buoyant jets.	Assess the extent of contaminant transport, including operative governing jets, plumes and buoyant jets mechanisms.	Nov 11th	Nov 18th	Week 11
Final Exam	2 hours	30 for Solid Waste 30 for Contaminant Transport	Solid Waste Management and Contaminant Transport	Critically analyse contaminant transport in the environment.	Formal Exam Period		

RELEVANT RESOURCES

Contaminant Transport Component:

There is no textbook prescribed for this part of the course. The Lecture Notes are reasonably detailed and numerous references are cited within them. The main references are:

1. Ippen, A. T. (editor), *Estuary and Coastline Hydrodynamics, M*cGraw-Hill Company, Inc., New York, 1966, [UNSW Library – 1 copy]
2. Bowden, K. F., *Physical Oceanography of Coastal Waters*, John Wiley & Sons, Ellis Horwood Series in Marine Science, Chichester, 1983, ISBN 0 85312 686 0, [UNSW Library – 1 copy]
3. Lewis, R. *Dispersion in Estuaries and Coastal Waters*, John Wiley & Sons, Chichester, 1997, ISBN 0 471 96162 0, [UNSW Library – 1 copy]
4. Fischer, H. B., List, E. J., Koh, R. C. Y., Imberger, J. and Brooks, N., *Mixing in Inland and Coastal Waters*, Academic Press Inc., 1979, ISBN 0 12 258150 4, [UNSW Library – 1 copy]
5. Chapra, S. C., *Surface Water-Quality Modeling*, The McGraw-Hill Companies, Inc., New York, 1997, ISBN 0 07 115242 3, [UNSW Library – 1 copy]
6. Appelo, C.A.J., Postma, D., 2005. Geochemistry, Groundwater, and Pollution, 2nd Ed. A.A. Balkema, Rotterdam, 649 pp. ISBN 04 1536 428 0.
7. Fetter C.W., 2008. Contaminant Hydrogeology. 2nd Ed. Waveland Press. 500 pp. ISBN-13: 978-1577665830
8. Fetter C.W., 2008. Contaminant Hydrogeology. 2nd Ed. Waveland Press. 500 pp. ISBN-13: 978-1577665830

Waste Management Component:

There is no textbook prescribed for this part of the course too. The Lecture Notes are reasonably detailed, and demonstrations will have good examples. The main references are:

Christensen, T., (Ed.), 2010. Solid Waste Technology & Management. Wiley.
Brunner, P.H. and Rechberger, H., Practical Handbook of Material Flow Analysis, Lewis (Publ,), 2004, ISBN 1-5667-0604-1

Christensen, T.H., Cossu, R., Stegmann, R., Sanitary Landfilling: Process, Technology and Environmental Impact, Academic Press, London, 1989.
Baccini, P. (Ed.), The Landfill, Reactor and Final Storage, Springer-Verlag, Berlin, 1989.

Tchobanoglous, G et al, 1993; Integrated Solid Waste Management, McGraw - Hill
The following references may be useful for assignments and to practitioners. They are available from the Library.

The rest of references and reading materials will be uploaded in Moodle.

DATES TO NOTE

Refer to My UNSW 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

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