## School of Engineering

# CHEE3690: Environ. Process Technology

Callaghan
Semester 1 - 2024

COURSE OUTLINE

# OVERVIEW

**Course Description**

Environmental Process Technology course is designed to provide you with an understanding of the principles, processes and regulations involved in the treatment and sustainable management of potable water and municipal wastewater cycle.
The course covers the role of various unit operations and the design approach involved in the water treatment processes. The key objective of the course is to ensure you are able to take an integrated approach to design of water infrastructure for managing our urban water cycle and understand the water-energy nexus.
The course will involve multiple visits to water and wastewater treatment plants to gain practical exposure to the operational aspects. The course will also include a comprehensive case study on designing a wastewater treatment facility with a particular focus on energy recovery.

**Academic Progress Requirements**

Nil

**Contact Hours**

**Callaghan**
**Lecture**
Face to Face On Campus
4 hour(s) per week(s) for 12 week(s)
Please note that site visits are held on 3 occasions and replace the lecture.

**Unit Weighting**

10

**Workload**

Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

# CONTACTS

**Course Coordinator**

**Callaghan**
Dr Subhasish Mitra
Subhasish.Mitra@newcastle.edu.au
(02) 40339208
Consultation:
Appointment via email.

**Teaching Staff**

Other teaching staff will be advised on the course Canvas site.

**School Office**

**School of Engineering**
EAG02
EA Building
Callaghan
E: seng-admin@newcastle.edu.au
9.00am - 5.00pm (Monday to Friday)

# SYLLABUS

**Course Content**

The course introduces a range of environmental protection technologies applied to the treatment of water streams. It covers both the theoretical and applied principles and practices for a range of potable water and municipal wastewater treatment methods. For potable water the topics include:

1. Water supply sources and management strategies
2. Water quality characteristics and regulations
3. Water treatment technologies
4. Unit operations (mixing, sedimentation, and disinfection) and their design
5. Recycled water
6. Integration of renewable energy to water treatment

For municipal wastewater the topics include:

1. Wastewater quality - concept of COD and BOD
2. Clarifier - theory and design
3. Principles and models describing carbonaceous content removal, and nitrification, and denitrification process
4. Modelling of Activated sludge process
5. Carbon emission and energy management
6. Overview of aeration methods, oxygen transfer, equipment design (pump and blower), and line sizing
7. Sludge dewatering
8. Anaerobic digestion for bioenergy utilisation

**Course Learning Outcomes**

**On successful completion of this course, students will be able to:**

1. Identify the key issues associated with effective management of water resources for urban communities.

2. Apply the basic principles that underpin physical, chemical and biological treatment of both potable and wastewater streams to simple problems.

3. Analyse the available information on influent and effluent water conditions, and set the design parameters for treatment processes necessary to meet water quality requirements.

4. Create an appropriate unit operations process that meets the required water quality standard.

5. Quantify the energy requirements associated with biological wastewater treatment plants.

**Course Materials** Nil

# SCHEDULE

| Week | Week Begins | Topic | Learning Activity | Assessment Due |
|---|---|---|---|---|
| **1** | 26 Feb | Introduction to potable water quality, raw water characteristics, catchment and management, treatment process and associated chemistry. | Lecture by the course coordinator and industry guest lecturers, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ1) due by 3rd Mar Sunday 5 pm. Numerical quiz (NQ1) distribution by 3rd Mar Sunday 5 pm. |
| **2** | 4 Mar | Risk and safety guidelines for potable water industry, unit operations of potable water treatment process. | Lecture by the industry guest lecturers, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ2) due by 10th Mar Sunday 5 pm. |
| **3** | 11 Mar | Process of recycling wastewater, Emerging, Niche & Renewable Technologies for water treatment | Lecture by the industry guest lecturers, interactive session including discussion, tutorial and the site visit 1 (Grahamstown WTP). | Multiple choice quiz (TQ3) due by 17th Mar Sunday 5 pm. |
| **4** | 18 Mar | Principle of mixing and particle settling, introduction to wastewater characterisation | Lecture by the course coordinator, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ4) due by 24th Mar Sunday 5 pm. Numerical quiz (NQ1) due by 19th Mar, Tuesday 11:59 pm. Numerical quiz (NQ2) distribution by 24th Mar, Sunday 5 pm. |
| **5** | 25 Mar | Wastewater treatment process and design of clarifier system. | Lecture by the course coordinator, interactive session including discussion, tutorial, and the site visit 2 (Raymond Terrace WWTP). | Multiple choice quiz (TQ5) due by 31st Mar Sunday 5 pm. |
| **6** | 1 Apr | Role of micro-organisms and processes for biological nitrogen removal. | Lecture by the industry guest lecturer, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ6) due by 7th April Sunday 5 pm. |
| **7** | 8 Apr | Bioreactor design based on activated sludge process for nitrogen removal. | Lecture by the industry guest lecturer, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ7) due by 14th April Sunday 5 pm. Numerical quiz (NQ2) due by 16th April, Tuesday 11:59 pm. Numerical quiz (NQ3) distribution by 14th April, Sunday 5 pm. |
| **Mid-Semester Recess** | | | | |
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| **8** | 29 Apr | Carbon and energy management, process design of aeration, pumping system and line sizing. | Lecture by the course coordinator and the industry guest lecturer, interactive session including discussion, and tutorial. | Multiple choice quiz (TQ8) due by 5th May Sunday 5 pm. |
| **9** | 6 May | Dewatering and anaerobic digestion | Lecture by the course coordinator, interactive session including discussion, tutorial and site visit 3 (Cessnock WWTP) | Multiple choice quiz (TQ9) due by 12th May Sunday 5 pm. Numerical quiz (NQ3) due by 14th May, Tuesday 11.59 pm. |

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|---|---|---|---|---|
| **10** | 13 May | Design case study workshop | Hands on design calculations demonstrated by the course coordinator, interactive session including discussion. | |
| **11** | 20 May | Design case study workshop | Hands on design calculations demonstrated by the course coordinator, interactive session including discussion. | |
| **12** | 27 May | Design case study workshop | Hands on design calculations demonstrated by the course coordinator, interactive session including discussion. | Design case study report due by 9th Jun, Sunday 11.59 pm. |
| **13** | 3 Jun | | | |
| **Examination Period** | | | | |
| **Examination Period** | | | | |

# ASSESSMENTS

This course has 2 assessments. Each assessment is described in more detail in the sections below.

| | Assessment Name | Due Date | Involvement | Weighting | Learning Outcomes |
|---|---|---|---|---|---|
| **1** | Quizzes | multiple choice quiz: Mar 3, Mar 10, Mar 17, Mar 24, Mar 31, Apr 7, Apr 14, May 5, May 12.<br>numerical quiz: Mar 19, Apr 16, May 14. | Individual | 50% | 1, 2, 3, 4, 5 |
| **2** | Written Assignment | June 9 | Individual | 50% | 1, 2, 3, 4, 5 |

**Late Submissions** The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

## Assessment 1 - Quizzes

**Assessment Type** Quiz
**Purpose** The online quizzes test the theoretical knowledge while the numerical quizzes test the quantitative understanding of the topics covered.
**Description** Nine online multiple choice quizzes and three numerical quizzes involving long calculations. Supporting document showing step-by-step calculations must be submitted.
**Weighting** 50%
**Due Date** multiple choice quiz: Mar 3, Mar 10, Mar 17, Mar 24, Mar 31, Apr 7, Apr 14, May 5, May 12.
numerical quiz: Mar 19, Apr 16, May 14.
**Submission Method** Online
Take home quizzes submitted through CANVAS.
**Assessment Criteria** All multiple choice questions are assessed on the basis of number of correct responses. Numerical problems are assessed on the overall approach and accuracy of the answers.
**Return Method** Online
**Feedback Provided** Online - Solution to all quizzes will be provided following the corresponding submission due date. Solutions will be discussed in the class and posted on CANVAS. Individual feedback provided on CANVAS.

## Assessment 2 - Written Assignment

| | |
|---|---|
| **Assessment Type** | Case Study / Problem Based Learning |
| **Purpose** | The design case study assignment simulates the "theory to practice" component of the course through an organised mini-project activity. It aims to test the overall understanding of the wastewater treatment process utilising the knowledge gained throughout the course to design a practical wastewater treatment facility through an independent endeavour. |
| **Description** | The case study involves design of a wastewater treatment process that will provide an allowable effluent quality suitable to discharge to the environment. Major units such as bioreactor, clarifier, chlorination and UV disinfection system will be designed along with a consideration to the electrical energy consumption and utilisation of biomass produced onsite to meet some of the plant energy demand. |
| **Weighting** | 50% |
| **Due Date** | June 9 |
| **Submission Method** | Online<br>Submission on CANVAS through Turinitin check. |
| **Assessment Criteria** | A well written report clearly presenting an executive summary, problem statement, background, appropriate literature review, design philosophy, suitable assumptions, major design outcomes and sensitivity study (where applicable) and recommendations along with appropriate supporting calculations with acceptable accuracy. |
| **Return Method** | Online |
| **Feedback Provided** | Online - . Feedback provided in annotated copy of the individual reports. |

# ADDITIONAL INFORMATION

**Grading Scheme** This course is graded as follows:

| Range of Marks | Grade | Description |
|---|---|---|
| 85-100 | High Distinction (HD) | Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives. |
| 75-84 | Distinction (D) | Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives. |
| 65-74 | Credit (C) | Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes. |
| 50-64 | Pass (P) | Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes. |
| 0-49 | Fail (FF) | Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action. |

*Skills are those identified for the purposes of assessment task(s).

**Attendance** Attendance/participation will be recorded in the following components:

- Lecture (Method of recording: )

**Communication Methods** Communication methods used in this course include:

| | |
|---|---|
| **Course Evaluation** | Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement. |
| **Oral Interviews (Vivas)** | As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule. |
| **Academic Misconduct** | All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35. |
| **Adverse Circumstances** | The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:<br>1. the assessment item is a major assessment item; or<br>2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;<br>3. you are requesting a change of placement; or<br>4. the course has a compulsory attendance requirement.<br>Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:<br>https://policies.newcastle.edu.au/document/view-current.php?id=236 |
| **Important Policy Information** | The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at: https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University. |

**Graduate Profile Statements**

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers):

| UON Att. | University of Newcastle Bachelor of Engineering Graduate Profile Statements/ Engineers Australia Stage 1 competency statements | Taught | Practised | Assessed | Skill Level (1-4) |
|---|---|---|---|---|---|
| | **Professional Attributes** | | | | |
| 11 | 3.1. Ethical conduct and professional accountability | ✓ | | | 2 |
| 12 | 3.2. Effective oral and written communication in professional and lay domains. | ✓ | ✓ | ✓ | 3 |
| 13 | 3.3. Creative, innovative and pro-active demeanour. | ✓ | | | 2 |
| 14 | 3.4. Professional use and management of information. | ✓ | | | 3 |
| 15 | 3.5. Orderly management of self, and professional conduct. | | | | |
| 16 | 3.6. Effective team membership and team leadership. | | | | |
| | **Engineering Ability** | | | | |
| 7 | 2.1. Application of established engineering methods to complex engineering problem solving. | ✓ | ✓ | ✓ | 3 |
| 8 | 2.2. Fluent application of engineering techniques, tools and resources. | ✓ | ✓ | ✓ | 3 |
| 9 | 2.3. Application of systematic engineering synthesis and design processes. | ✓ | ✓ | ✓ | 3 |
| 10 | 2.4. Application of systematic approaches to the conduct and management of engineering projects. | ✓ | | | 2 |
| | **Knowledge Base** | | | | |
| 1 | 1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. | ✓ | ✓ | ✓ | 3 |
| 2 | 1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. | ✓ | ✓ | ✓ | 3 |
| 3 | 1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline. | ✓ | ✓ | ✓ | 3 |
| 4 | 1.4. Discernment of knowledge development and research directions within the engineering discipline. | ✓ | | | 3 |
| 5 | 1.5. Knowledge of contextual factors impacting the engineering discipline. | ✓ | ✓ | ✓ | 2 |
| 6 | 1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline. | ✓ | ✓ | | 2 |

*This course outline was approved by the Head of School on 29/01/2024. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.*