



UNSW Course Outline

BABS3200 Synthetic Biology - 2024

Published on the 03 Sep 2024

General Course Information

Course Code : BABS3200

Year : 2024

Term : Term 3

Teaching Period : T3

Is a multi-term course? : No

Faculty : Faculty of Science

Academic Unit : School of Biotechnology and Biomolecular Sciences

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

Synthetic biology is the design and construction of novel biological systems or the redesign of existing biological systems. A fundamental aim of synthetic biology is to make biology easier to engineer through the application of engineering principles and standardisation of biological components. Central to this engineering is the deconstruction of biological systems into

components (e.g., DNA, enzymes, genetic circuits, metabolic pathways, etc.) that can be uncoupled from each other, abstracted into predictable forms, characterised, and reassembled into novel functional systems to solve specific problems.

This course will give students insight into the assembly and design of interchangeable biological parts that form the basis of synthetic biology. The course includes lectures that describe the standardised assembly of DNA and genes into functioning devices, including biological circuits, DNA/RNA/protein nanostructures, and engineered organisms. A particular emphasis is placed on using online tutorials and computer labs to apply engineering principles for the design of a biological system, followed by wet labs to build and evaluate the biological function of the assemblages. This design - build - test paradigm reinforces an understanding of how biological systems are not static processes to be memorised, but rather, dynamic systems which can be manipulated and built from the ground-up.

Course Aims

This course aims to introduce students to the concept of building biological systems from standardised biological building blocks. Building on second year molecular biology concepts, the course aims to teach students that biological systems can be deconstructed into individual components that can be characterised and assembled into devices of diverse functions. The course also aims to introduce students to contemporary research in synthetic biology, including the generation of biofuels, bionanotechnology, microbial synthesis of pharmaceuticals, and the design of biosensors for biomedical or environmental applications.

Course Learning Outcomes

| Course Learning Outcomes |
|---|
| CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation. |
| CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology. |
| CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms. |
| CLO4 : Evaluate the ethical and social impact of contemporary synthetic biology technology, including applications in genome construction and human genome editing. |
| CLO5 : Effectively communicate synthetic biology concepts in both written and verbal form, to a non-expert audience. |

| Course Learning Outcomes | Assessment Item |
|---|--|
| CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation. | <ul style="list-style-type: none"> • Midterm Test • Final Exam • Laboratory Reports • Synthetic Biology Innovation Project |
| CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology. | <ul style="list-style-type: none"> • Midterm Test • Final Exam • Laboratory Reports • Synthetic Biology Innovation Project |
| CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms. | <ul style="list-style-type: none"> • Midterm Test • Final Exam • Laboratory Reports • Synthetic Biology Innovation Project |
| CLO4 : Evaluate the ethical and social impact of contemporary synthetic biology technology, including applications in genome construction and human genome editing. | <ul style="list-style-type: none"> • Synthetic Biology Innovation Project |
| CLO5 : Effectively communicate synthetic biology concepts in both written and verbal form, to a non-expert audience. | <ul style="list-style-type: none"> • Synthetic Biology Innovation Project |

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams | Echo 360

Learning and Teaching in this course

Synthetic biology concepts will be covered within in-person lectures and hands-on laboratory classes.

Assessments

Assessment Structure

| Assessment Item | Weight | Relevant Dates |
|--|--------|---|
| Midterm Test Assessment Format: Individual | 20% | Start Date: Not Applicable Due Date: 01/10/2024 02:00 PM |
| Final Exam Assessment Format: Individual | 30% | |
| Laboratory Reports Assessment Format: Individual | 30% | Due Date: Not Applicable |
| Synthetic Biology Innovation Project Assessment Format: Group | 20% | Due Date: 12/11/2024 02:00 PM |

Assessment Details

Midterm Test

Assessment Overview

You will complete a 60-minute mid-term test, designed as a summative assessment of the learning outcomes for the topics covered in Weeks 1-4 inclusive (lecture material only). The midterm test is typically scheduled in Week 5 with a single attempt provided. The test will be in-person, invigilated, and conducted through an online safe exam browser. The test consists of short answer questions. Feedback will be provided through the gradebook to link incorrect answers to topic learning outcomes and via a generalised class feedback discussion in lectures within 10 working days.

Course Learning Outcomes

- CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation.
- CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology.
- CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms.

Detailed Assessment Description

The test will be in-person, invigilated, and conducted through an online safe exam browser. The test consists of short answer questions.

Assessment Length

1 hour

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

No generative AI use permitted

Final Exam

Assessment Overview

The final exam is designed to summarise your learning and problem-solving skills on all topics delivered across the term, including material from lectures, tutorials, and workshops. The exam is typically 2 hrs and consists of MCQ, short numerical, and short answer responses - details will be confirmed during the course. The examination will occur during the official university examination period. The exam will be in-person, invigilated, and conducted through an online safe exam browser. Feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation.
- CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology.
- CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms.

Detailed Assessment Description

The exam is typically 2 hrs and consists of MCQ, short numerical, and short answer responses - details will be confirmed during the course.

Assessment Length

2 hours

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

No generative AI use permitted

Laboratory Reports

Assessment Overview

The hands-on building of biological systems is central to the teaching of synthetic biology. You

will undertake a series of wet lab practicals to reinforce the Design - Build - Test paradigm of synthetic biology. The practicals will be divided into modules that will begin with a computational design aspect, e.g., design and annotation of a gene circuit in a computer lab. You will subsequently build the design in wet labs and measure the result/output. This task involves the submission of two lab reports, due in Weeks 5 and 8. Each lab report is worth 15% of the total course mark. Feedback is provided within 10 working days of submission.

Course Learning Outcomes

- CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation.
- CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology.
- CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms.

Detailed Assessment Description

This task involves the submission of two lab reports that will involve analysing data and answering questions.

Assignment submission Turnitin type

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

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.

If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see [here](#).

AI is allowed for simple editing of the lab report answers.

Synthetic Biology Innovation Project

Assessment Overview

The Group Project will involve you working in small groups (4-5 students) to develop a synthetic biology invention or idea. The task involves the submission of a 3-page group report and giving a 10-minute group presentation, which details the invention and the science that supports the idea. The report and presentation will be assessed by the course administrators on the analysis of peer-reviewed literature, implementation of the design/engineering principles described in lectures, and scientific communication and presentation skills. The report and presentation will be delivered in Week 10, and each task is worth 10% of the total course mark. A formative peer review component is included for students to provide feedback on the contribution of fellow group members. Final grade and feedback will be provided within 10 working days via Moodle.

Course Learning Outcomes

- CLO1 : Fabricate synthetic biological systems by applying engineering principles and biological part standardisation.
- CLO2 : Describe the DNA/RNA/protein hierarchy of synthetic biology and the Design - Build - Test paradigm employed in synthetic biology.
- CLO3 : Propose strategies for creating novel biological functions through the editing and assembly of DNA components for applications in gene circuits, nucleic acid and protein nanostructures, and enzymatic capabilities of whole organisms.
- CLO4 : Evaluate the ethical and social impact of contemporary synthetic biology technology, including applications in genome construction and human genome editing.
- CLO5 : Effectively communicate synthetic biology concepts in both written and verbal form, to a non-expert audience.

Detailed Assessment Description

The task involves the submission of a 3-page group report and giving a 10-minute group presentation, which details the invention and the science that supports the synthetic biology idea/innovation.

Generative AI Permission Level

Planning/Design Assistance

You are permitted to use generative AI tools, software or services to generate initial ideas, structures, or outlines. However, you must develop or edit those ideas to such a significant extent that what is submitted is your own work, i.e., what is generated by the tool, software or service should not be a part of your final submission. You should keep copies of your iterations to show your Course Authority if there is any uncertainty about the originality of your work.

If your Convenor has concerns that your answer contains passages of AI-generated text or media

that have not been sufficiently modified you may be asked to explain your work, but we recognise that you are permitted to use AI generated text and media as a starting point and some traces may remain. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see [here](#).

The use of AI is permitted for planning and design of the group project innovation.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

Achieve a composite mark of at least 50 out of 100.

Course Schedule

| Teaching Week/Module | Activity Type | Content |
|--------------------------------------|---------------|--|
| Week 1 : 9 September - 15 September | Lecture | Mon Lecture 1: Introduction to synthetic biology Wed Lecture 2: DNA and gene assembly Fri Lecture 3: Building synthetic genomes |
| | Laboratory | Tuesday 2-5 pm: Cellular biosensor practical week 1 |
| Week 2 : 16 September - 22 September | Lecture | • Mon Lecture 4: Genome editing and engineering • Wed Lecture 5: Synthetic bio-circuitry: Transcriptional • Fri Lecture 6: Synthetic bio-circuitry: Translational |
| | Laboratory | Tuesday 2-5 pm: Cellular biosensor practical week 2 |
| Week 3 : 23 September - 29 September | Lecture | Mon Lecture 7: Synthetic bio-circuitry: Post-translational Wed Lecture 8: Building synthetic metabolic pathways Fri Lecture 9: Mid-term exam revision |
| | Laboratory | Tuesday 2-5 pm: Cellular biosensor practical week 3 |
| Week 4 : 30 September - 6 October | Lecture | Wed Lecture 10: DNA nanostructures Fri Lecture 11: Cellular agriculture |
| | Assessment | Tuesday 2 pm - Mid-term exam |
| | Laboratory | Tuesday 2-5 pm: Cellular biosensor practical week 4 |
| Week 5 : 7 October - 13 October | Lecture | Wed Lecture 12: DNA nanotechnology Fri Lecture 13: Conjugation chemistry: connecting DNA and proteins |
| | Laboratory | Tuesday 2-5 pm: DNA nanotechnology 1 |
| Week 6 : 14 October - 20 October | Other | No contact week. Students are encouraged to work on the group project. |
| Week 7 : 21 October - 27 October | Lecture | Mon Lecture 14: Cryo-electron microscopy Wed Lecture 15: Synthetic and resurrected viruses for bio-control of cane toads and other pests Fri Lecture 16: Evolutionary methods in synthetic biology |
| | Laboratory | Tuesday 2-5 pm: DNA nanotechnology 2 |
| Week 8 : 28 October - 3 November | Lecture | Mon Lecture 17: Synthetic methods in evolutionary biology Wed Lecture 18: Entrepreneurship in synthetic biology Fri Lecture 19: Modular approaches to synthetic proteins |
| | Laboratory | Tuesday 2-5 pm: DNA nanotechnology 3 |
| Week 9 : 4 November - 10 November | Lecture | Mon Lecture 21: Construction of a synthetic protein motor Wed Lecture 22: CAR-T immune cell engineering Fri Lecture 23: Synthetic biology in Zebrafish |
| | Tutorial | Tuesday 2-5 pm: Group project tutorial |
| Week 10 : 11 November - 17 November | Lecture | Mon Lecture 24: Synthetic biology and society Wed Lecture 25: Enhancing plants through synthetic design Fri Lecture 26: Final exam revision |
| | Assessment | Tuesday 2-5 pm: Group project presentations |

Attendance Requirements

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

General Schedule Information

In-person live lectures are each Monday 12-1 pm, Wednesday 2-3 pm, and Friday 12-1pm. The lectures are strongly encouraged to attend the live lectures and participate by asking questions, and review the lecture recordings. Laboratory/tutorial classes run on each Tuesday at 2-5 pm and attendance is required.

Course Resources

Prescribed Resources

None

Recommended Resources

None

Additional Costs

None

Course Evaluation and Development

Feedback will be provided for the midterm exam, lab reports, and for the group project.

Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|----------|----------------|-------|----------|----------|--------------|-------------------------------------|-----------------|
| Convenor | Dominic Glover | | 301E | 93853382 | M-F 9-5 pm | Yes | Yes |

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the [UNSW Student Code of Conduct Website](#).

Academic Honesty and Plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The [Current Students site](#),
- The [ELISE training site](#), and
- The [Use of AI for assessments](#) site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: <https://student.unsw.edu.au/special-consideration>

Important note: UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- [The Current Students Gateway](#)
- [Student Support](#)
- [Academic Skills and Support](#)
- [Student Wellbeing, Health and Safety](#)
- [Equitable Learning Services](#)
- [UNSW IT Service Centre](#)
- Science EDI Student Initiatives, [Offerings](#) and [Guidelines](#)