



Course Outline

BABS3031/ BABS3631

Biotechnology and Bioengineering
Biotechnology and Bioengineering (Advanced)

School Biotechnology and Biomolecular Sciences

Faculty of Science

Term 2, 2021

1. Staff

Position	Name	Email	Locations	Consultation Times
Course Convenor	A/Prof. Christopher Marquis	c.marquis@unsw.edu.au	D26, Level 3 320A	By appointment

Please refer to the course manual or Moodle site for demonstrators/ tutors involved in this course.

2. Course information

Units of credit: 6

Pre-requisite(s): General science background in biosciences to stage 2

Standard Grading (HD, DN, CR, PS, FL) will apply to this course in 2021

Teaching times – Note, at the time of writing this document, it was assumed that the course will be delivered entirely on-line in 2021

- Lectures: Mon 9-11, Tues 9-10
 - Online via Collaborate Ultra in Moodle – Attendance expected, sessions recorded for asynchronous access. Lectures will be live: not pre-recorded
- Tutorials: Open Q&A sessions to be organised for on-line interaction in Week 1 to assist with understanding solutions to tutorial questions or help with assignments. Likely Mondays and/or Tuesdays
 - Extra ad hoc tutorials to be organised for BABS3631
- Labs: Wed 10-1 or Wed 2-5 : Attend one only
 - In class attendance and On-line Delivery (Weeks 1-9) – Attendance compulsory

2.1 Course summary

In order to bring new biotechnology products to the market, scalable bioprocesses must be developed and validated. This course covers the bioprocessing and economic principles involved in the operation, development and design of large scale biotechnology-based processes. It includes analysis of fermentation kinetics, batch and continuous modes of operation, bioprocess optimisation, principles of fermentor scale up, downstream processing and bioprocess design, as well as principles of economic feasibility analysis. Selected bioprocesses will be used to develop an understanding of fundamental bioprocessing principles, including process scale-up. Examples will be drawn from major biotechnology sectors, including biofuels, biopharmaceutical manufacture and manufacture of other bioproducts from bacterial, yeast and mammalian hosts. Laboratory sessions and problem-solving tutorials (including computer-based classes) will supplement lecture material. At least one detailed case study will be undertaken by students which will investigate economic and technical feasibility of a bioprocess.

2.2 Course aims

- Describe the features and functions of basic biochemical engineering flowsheets
- Explain the concept of bioprocess flowsheets and mass balances
- Describe the principles of the design and operation of major units involved in the manufacture of biotechnology products
- Explain the impact of modern bioscience disciplines in bioprocessing

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Demonstrate competency in quantitative methods in biotechnology and bioprocessing
2. Apply basic bioengineering principles to fermentation and downstream bioprocessing
3. Recognise and apply knowledge of the basics of design of bioprocessing units
4. Discuss the issues around building a processing plant to manufacture a biological product from fermentation and cell culture processes. In addition, you will be able to convey the impact of modern biotechnology innovation and the bioengineering space.
5. Demonstrate extended knowledge in one area of bioprocessing via independent research working in pairs (**BABS3631 only**)

2.4 Relationship between course learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Related Tasks & Assessment
CLO 1	Demonstrate competency in quantitative methods in biotechnology and bioprocessing	Tutorials, tests, lab reports
CLO 2	Apply basic bioengineering principles to fermentation and downstream bioprocessing	Design project (Advanced), tests
CLO 3	Recognise and apply knowledge of the basics of design of bioprocessing units	Flowsheet assignment, design assignment
CLO 4	Understand the issues around building a processing plant to manufacture a biological product from fermentation and cell culture processes.	Tutorials, tests
CLO 5 (BABS3631 only)	Demonstrate extended knowledge in one area of bioprocessing via independent research	Independent research and Written report

3. Strategies and approaches to learning

3.1 Learning and teaching activities

Throughout the course, students are encouraged to develop problem-solving skills and to critically evaluate concepts, ideas and research results by participating in all face-to-face activities such as lectures, tutorials and practical classes. As a result of the current restrictions due to COVID-19, the course in 2021 is designed for hybrid delivery. Course resources will all be made accessible via the course Moodle page.

Lectures serve to emphasize principles germane to bioprocessing. Lectures are supported by weekly recommended readings accessible [here](#). The lectures provide the core material for the course and will be assessable through online quizzes *in lieu* of face-to-face exams. Most lectures will closely follow the textbook readings however students are encouraged to extend their knowledge by reading from a variety of sources. Lectures will be delivered on-line at the designated times using Collaborate Ultra within Moodle. Lecture notes and recordings are also available on the course Moodle website. Attendance at lectures is not compulsory but strongly encouraged, even though they will all be delivered via Moodle Collaborate Ultra

Tutorials are designed to assist students with the solving the tutorial questions and to some extent, assisting with lab and other activities. Work will be guided through ad hoc on-line content and video-based solutions posted on Moodle.

Laboratory based experimentation is an essential part of scientific practice. The practicals in this course are designed for students to learn and enhance their lab techniques and are designed to complement the lecture series. Labs will comprise both directed computer-based exercises and wet labs. In weeks 2 and 3, the practical components will be exercises undertaken using the program Superpro Designer. In week 4, you will be introduced to the program Berkley Madonna; you will use this to undertake part of your major assignment. You will individually be provided with temporary licenses for this program to allow you to work from home, which will be communicated to you through Moodle. Wet labs will be run on-campus and synchronously delivered on-line in weeks 5, 7 and 8. Pre-lab videos for the wet labs will be available and lessons have been created for the flowsheet analysis program Superpro Designer. Attendance will be on campus and via Collaborate Ultra and is compulsory.

3.2 Expectations of students

Students are generally expected to be regular and punctual in attendance at all classes (80% attendance required). In the case of remote learning, it is expected that you will attend lectures and all of the lab components.

Lectures, as well as providing facts, will provide an understanding of processes by which scientific enquiries and discoveries are made. By referring to examples, lecture material should illustrate how scientific theories can be developed from experimental results. The possibilities for alternative interpretations yielding controversy in theories, especially in certain fields of current interest will be presented. Following such examples, students are encouraged to undertake similar enquiry themselves, depending on their interests. Note: all lectures are live, not prerecorded.

Tutorials are small group activities that are designed to help students to revise the lecture materials, so that they can keep up to date with the content. In light of the hybrid teaching mode for this year, formal scheduled in class tutorials will be replaced with ad hoc problem-solving sessions to supplement on-line learning resources.

Laboratory classes will complement lecture materials and will provide opportunities for students to have practical experience and gain deeper understanding of bioprocessing systems. Therefore, attendance at all laboratory classes is mandatory (roll will be taken and the absence from classes is considered as unsatisfactory performance). By participating in the online laboratory investigations,

students are encouraged to think about processes of experimental enquiry.

Social networks (i.e. Facebook, Twitter etc) will not be used to share class materials and a way to contact academics including demonstrators/tutors involved in this course. If students have course-related questions, they are encouraged to use discussion forums on the course's Moodle website, which is monitored regularly. If more help is needed, students may send enquiries or requests for appointments from their UNSW email. When sending an email to the course coordinator, a student must state their name, student number and the course they are enrolled in.

Students are encouraged to consult with the course authority if in doubt as to their progress.

4. Course schedule and structure

This course consists of 57 hours of class contact hours. You are expected to take an additional 60-80 hours of non-class contact hours to complete assessments, readings and exam preparation.

Week	Lecture 1 (1hrs) Monday 9-11	Lecture 2 (2hr) Tuesday 9-10	Tutorial Sheet work progress	Practical (Choose One) Wednesday 10-11 or Wednesday 2-5
Week 1	Course Introduction, Flowsheets, Unit operations	Problem solving, Flowsheet examples and mass balances. Focus on biofuels and recombinant insulin		On-line only Introduction to Tutorials Discuss Assignment and Berkley Madonna
Week 2	Stoichiometry and mass balancing. Mass and redox balancing. Worked examples on C- and N-balancing and redox balancing	Introduction to kinetics Bioreaction rates and different reactor modes	1h/wk Problem-Solving Tutorial Sheet 1	SuperPro Task 1
Week 3	Public Holiday	Kinetic models and modelling	1h/wk Problem-Solving Tutorial Sheet 2	SuperPro Task 2
Week 4	Oxygen Mass Transfer	Calculations around oxygen transfer, uptake, mixing. Cell Bioreactors	1h/wk Problem-Solving Tutorial Sheet 3	Review Flowsheet tasks and Assignment progress QUIZ 1 (Weeks 1,2)
Week 5	Cell bioreactors	Cell Bioreactors Biofuels and Enzymes	1h/wk Problem-Solving Tutorial Sheet 4	Wet Lab (Lab 11, E26) Oxygen Mass transfer
Week 6		FLEXIBILITY WEEK		
Week 7	Enzyme Bioreactors	QUIZ 2 (Weeks 3,4,5)	1h/wk Problem-Solving Tutorial Sheet 5	Wet Lab (Lab 11, E26) Filtration, Diafiltration

Week 8	Filtration and Diafiltration	Calculations on cross-flow filtration and diafiltration	1h/wk Problem-Solving Tutorial Sheet 6	Wet Lab (Lab 11, E26) Cellulose Hydrolysis I and II
Week 9	Process Chromatography	Calculations for sizing and running chromatography processes. Purification cases studies	1h/wk Problem-Solving Tutorial Sheet 7	Lab Review
Week 10	Biotherapeutics Processing	Biotherapeutics, validation and single-use bioprocess units. Course Summary	1h/wk Problem Solving Tutorial Sheet 8	No Class
Week 11	Stuvac No class	No class	No class	No class
Week 12	Exam Period No class	No class	No class	EXAM/QUIZ (Weeks 7,8,9,10)

5. Assessment

5.1 Assessment tasks

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Assessment task and methods		Weighting (%)	Submission methods	Mark and feedback methods	Week due
Formative assessments					
Assessment: On-line Stack Questions on Units and Dimensionless Numbers		0	Online submission by the end of week 2 though not compulsory	No mark. Work checked for completion	2
Summative assessments					
Assessment 1: Assessment on bioprocess kinetics	A) Kinetics solutions using Berkley Madonna B) Bioprocess Report	24	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Feedback provided within 10 working days.	8
Assessment 2: Laboratory work	Reports Portfolio	20	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Feedback provided within 10 working days.	10
Assessment 3: 2 x Quizzes - 8% (Quiz 1) and 18% (Quiz 2)		26	Combination of multiple choice and short answer	Solutions will be reviewed following the quiz (delivered by Moodle Quiz)	3,7
Assessment 4: 1 Exam 30%		30	Combination of multiple choice and short answer		12

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Assessment task and methods		Weighting (%)	Submission methods	Mark and feedback methods	Week due
Formative assessments					
Assessment 1: On-line Stack Questions on Units and Dimensionless Numbers		0	Online submission by the end of week 2	No mark. Work checked for completion	2
Summative assessments					
Assessment 1: Assessment on bioprocess kinetics and mRNA processes	A) Kinetics solutions using Berkley Madonna B) Project: Design for mRNA	30	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Feedback provided within 10 working days.	8*
Assessment 2: Laboratory work	Reports Portfolio	20	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Feedback provided within 10 working days.	10
Assessment 3: 2 x Quizzes - 8% (Quiz 1) and 16% (Quiz 2)		24	Combination of multiple choice and short answer	Solutions will be reviewed following the quiz	3,7
Assessment 4: 1 Exam 26%		26	Combination of multiple choice and short answer	Solutions will be reviewed following the quiz (delivered by Moodle Quiz)	12

*Part B has staggered progress dates; see Assignment Handout for detail

Further information

UNSW grading system: <https://student.unsw.edu.au/grades>

UNSW assessment policy: <https://student.unsw.edu.au/assessment>

5.2 Assessment criteria and standards

The major components of this course are the scientific content which is delivered through on-line lectures and other on-line material. This will be assessed by two quizzes and one exam, all undertaken on-line in Moodle, which will take the form of multiple choice and short answer questions. Another component is the laboratory work which will be assessed by written assignments since this is considered relevant to this material. More details on the assessment tasks and how they will be graded will be provided during the course (in the course manual or online via Moodle).

All assessments must be completed/attempted in order to pass the course though it is not essential to pass each course component. The course will have standard grading (HD, DN, CR, PS, FL) in 2021.

5.3 Submission of assessment tasks

Assignment submission

All assignments and quiz questions (multiple choice and short answer) will be submitted via Turnitin on Moodle (also please refer to the table provided in section 5.1). Requests for an extension of assignment deadline must be made direct to the course convenor. A request may not be granted unless evidence for the reason for late submission is supplied. Standard penalties for late submission are 5% per day including weekends.

Special consideration

Applications must be made via Online Services in myUNSW. Students must obtain and attach Third Party documentation before submitting the application. Failure to do so will result in the application being rejected.

A document will be posted on the Moodle Site to fully explain the Special Consideration Procedure. Information can also be accessed [here](#). In particular, for issues relating to on-line quizzes please note the following:

If a student experiences a technical or connection problem during an online assessment, they should take the following steps:

1. *Take screenshots of as many of the following as possible:*
 - *error messages*
 - *screen not loading*
 - *timestamped speed tests*
 - *power outage maps*
2. *If the Course Coordinator or Tutor is present online during the assessment in chat, make contact immediately and advise them of the issue.*
3. *Submit a Special Consideration application immediately at the conclusion of your assessment and upload your screenshots*

5.4. Feedback on assessment

Students will receive constructive feedback on their assignments in a timely manner (within 2 weeks after submissions as instructed in the UNSW assessment Policy). The delivery method of feedback may vary depending on the assessment type. Brief outline of assessment feedback is presented in the table provided in section 5.1. Full details will be provided in the course manual and on the course Moodle site.

6. Academic integrity, referencing and plagiarism

There's no recommended referencing style for this course thus, students can choose a style they desire from an accepted journal in the field. However, the chosen style needs to be used throughout an assignment, keeping the consistency is valued the most.

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.¹ 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 and **plagiarism** can be located at:

- The *Current Students* site <https://student.unsw.edu.au/plagiarism>, and
- The *ELISE* training site <http://subjectguides.library.unsw.edu.au/elise/presenting>

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

7. Diversity and Inclusion

The School of BABS is dedicated to creating a positive, inclusive educational environment that embraces diversity in all forms and rejects any form of hostile workplace, discrimination, or bullying. We have a clear statement of behavioural expectations (as well as definitions of discrimination, (sexual) harassment and bullying, which can be found here: <https://student.unsw.edu.au/harassment>). On this website, you can also find resources and contacts for reporting issues. In addition, the Science Equity, Diversity and Inclusion Working Group of the Faculty of Science have recently launched a set of Classroom Inclusivity Guidelines that all staff and students are striving to work under. They can be found here: <https://www.science.unsw.edu.au/our-faculty/classroom-inclusivity-guidelines>

Beyond the University and Faculty protocols, **it is my goal as course convenor to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honours your identities** (including race, gender, class, sexuality, religion, ability). To help accomplish this:

- If you choose, please let me and the class know your chosen name and pronouns.
- Your classmates and demonstrators (like many people) are still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please feel free to talk to me about it.
- As a participant in course discussions, you should also strive to honour the diversity of your classmates (e.g. make sure all voices are being heard, etc.).
- If you feel like your performance in the class is being impacted by your experiences outside of class, please do not hesitate to contact me.

Finally, the School recognises the added challenges faced by students during the coronavirus outbreak, in particular those related to teaching and learning remotely while public health is managed. Specific details on how this course will be managed are given throughout this manual and will be highlighted further in the first lecture, but please be assured I will strive to minimise stress to students while still endeavouring to deliver a high-quality learning experience

8. Readings and resources

Text Books and Course Manuals

This course has a suggested textbook to assist students' learning **Bioprocess Engineering Principles (2nd Edn. Preferably) by Pauline Doran (Elsevier)**. This is available from UNSW bookshop and UNSW library at open reserve/ high use collection. It is not essential to purchase this book. A week-by-week course reading list is provided, which includes some sections from the main text, whereby recommended readings for each week are specified. All readings can be accessed here:

https://ap01-a.alma.exlibrisgroup.com/leganto/public/61UNSW_INST/lists/3276579980001731?auth=local

Course Website (Moodle)

All students enrolled in courses offered at BABS will have access to the course Moodle site <https://moodle.telt.unsw.edu.au>. Please check this site regularly! This site will be used to distribute course notes and information and should be checked at regular intervals. This includes:

- Lecture handouts and lecture recordings
- Practical notes
 - pre-lab videos
 - Moodle lessons
 - online practical resources
- Tutorial resources
 - Tutorial questions
 - Timed release of tutorial solutions
- Assessments - detailed information on assessment tasks
 - gradebook
 - further information resulting from special consideration
 - Turnitin site for submission
- On-line testing
- Self-management resources
- Discussion portal

Resources

Literature Searching: <http://www.ncbi.nlm.nih.gov/pubmed>

UNSW Library: <http://www.library.unsw.edu.au>

¹ International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013

Study Areas

There are study areas where students can study or relax on the ground floor and first floor of the Biological Sciences Building, E26. (If the campus is open!!)

9. Administrative matters

Biosciences Student Office

Student Advisor (BABS)

Email: BABStudent@unsw.edu.au

Tel: +61 (2) 9385 8047

School Grievance Officer

Dr. Megan Lenardon

Email: m.lenardon@unsw.edu.au

Tel: +61 (2) 9385 1780

School Contact

Director of Teaching

Email: BABSteaching@unsw.edu.au

Faculty Contact

Associate Dean Teaching

Email: a.beavis@unsw.edu.au

Additional Websites

- BABS Office: <https://www.babs.unsw.edu.au/contact-babs>
- School of Biotechnology & Biomolecular Sciences: <https://www.babs.unsw.edu.au/>
- MyUNSW: <https://my.unsw.edu.au/>

10. Special Consideration

Students who believe that their performance, either during the session or in the end of session exams, may have been affected by illness or other circumstances may apply for special consideration. Applications can be made for compulsory class absences such as (laboratories and tutorials), in-session assessments tasks, and final examinations.

You must submit the application prior to the start of the relevant exam, or before a piece of assessment is due, except where illness or misadventure prevent you from doing so. If you become unwell on the day of the exam or fall sick during an exam, you must provide evidence dated within 24 hours of the exam, with your application. You must obtain and attach Third Party documentation before submitting the application. Failure to do so may result in the application being rejected.

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.

Further information on special consideration can be found at <https://student.unsw.edu.au/specialconsideration>

HOW TO APPLY FOR SPECIAL CONSIDERATION

The application must be made through Online Services in [myUNSW](#) (My Student Profile tab > My Student Services > Online Services > Special Consideration).

Students will be contacted via *their official university email* as to the outcome of their application. It is the responsibility of all students to regularly consult their official student email accounts and myUNSW in order to ascertain whether or not they have been granted further assessment.

11. Additional support for students

- The Current Students Gateway: <https://student.unsw.edu.au/>
- UNSW COVID-19 Response: <https://www.covid-19.unsw.edu.au/>
- FAQs for On-line Learning: <https://student.unsw.edu.au/online-study>
- Academic Skills and Support: <https://student.unsw.edu.au/academic-skills>
- Student Wellbeing, Health and Safety: <https://student.unsw.edu.au/wellbeing>
- Special Consideration: <https://student.unsw.edu.au/specialconsideration>
- Disability Support Services: <https://student.unsw.edu.au/disability-services>
- UNSW IT Service Centre: <https://www.it.unsw.edu.au/students/index.html>
- UNSW Academic Calendar Key Dates: <https://student.unsw.edu.au/dates>
- UNSW Handbook: <http://www.handbook.unsw.edu.au/2018/index.html>
- UNSW Learning Centre: <http://www.lc.unsw.edu.au/>
- Equitable Learning Services: <https://student.unsw.edu.au/els>
- Counselling and Support: <https://www.counselling.unsw.edu.au/>
- University Health Service: <http://www.healthservices.unsw.edu.au/>
- The Hub: <https://student.unsw.edu.au/hub>
- UNSW Careers and Employment Service: <http://www.careers.unsw.edu.au/>
- ARC- Student Life: <https://www.arc.unsw.edu.au/>
- UNSW Student Life: <https://www.unsw.edu.au/life>