Course Outline

BABS3031/ BABS3631

Biotechnology and Bioengineering
Biotechnology and Bioengineering (Advanced)

School Biotechnology and Biomolecular Sciences

Faculty of Science

Term 2, 2019

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

Teaching times and locations:

- Lectures: Mon 11-2 (Mathews D), Tues 2-4 (CLB3)
- Tutorials: Thu 9-10 or Fri 2-3 or Fri 3-4. All in Lab 102, D26
- Labs: Thu 2-5 (Lab 11, E26) or Fri 10-11 (Lab 11, E26)

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

- Understand basic biochemical engineering flowsheets
- Understand the concept of bioprocess flowsheets and heat/ mass balances
- Understand the principles of the design and operation of major units involved in the manufacture of biotechnology products
- Understand the impact of modern bioscience disciplines in biotechnology

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. Understand the issues around building a processing plant to manufacture a biological product from fermentation and cell culture processes. In addition, you will appreciate the impact of modern biotechnology innovation and the bioengineering space.
5. Undertake a mini project with practical component to extend knowledge in one area of bioprocessing **(BABS3631 only)**

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	**LO Statement**	**Program Learning Outcome (PLO)**	**Related Tasks & Assessment**
CLO 1	Demonstrate competency in quantitative methods in biotechnology and bioprocessing		Tutorials, test and exam
CLO 2	Apply basic bioengineering principles to fermentation and downstream bioprocessing		Design project, test and exam
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, test and exam
CLO 5 **(BABS3631 only)**	Undertake a mini project with practical component to extend knowledge in one area of bioprocessing		Lab work 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. Also, online learning materials will be made available via Moodle to further assist students' learning.

Lectures serve to emphasize certain principles covered in the text, provide an overview and connect the individual components of the course. They may also cover current ideas and research. The lectures provide a guide to the material need to cover for the course. Most lectures will closely follow the textbook however students are encouraged to extend their knowledge by reading from a variety of sources. Lecture notes and recordings are also available on the course Moodle website.

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.

Laboratory based experimentation is an essential part of modern science. The practicals in this course are designed for students to learn and enhance their lab techniques and are designed to complement the lecture series.

More details on learning activities and how they are going to assist students to achieve the intended learning outcomes will be provided during the course (the course manual and Moodle).

3.2 Expectations of students

Students are expected to be regular and punctual in attendance at all classes (80% attendance required). Many of the lecturers in this course are esteemed researchers and are taking time from their research to give lectures, so it is common courtesy to show appreciation by being present in the lectures.

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.

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. 80% attendance is required and if this requirement is not met, a grade of Absent Fail (AF) will be given (unless there's a reasoning for the absent).

Laboratory classes will complement lecture materials and will provide opportunities for students to have hands-on experience and gain deeper understanding of biological 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 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. These are 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 11-12	Lecture 2 (2hr) Tuesday 2-4	Tutorials (Choose One) Thursday 9-10 Friday 2-3, 3-4	Practical (Choose One) Thursday 2-5 Friday 10-11
Week 1	Course Introduction, Flowsheets, Unit operations	Problem solving, Flowsheet examples and mass balances		
Week 2	Stoichiometry and mass balancing. Introduction to kinetics	Mass and redox balancing. Worked examples on C- and N-balancing and redox balancing	1h/wk Problem-Solving	SuperPro Task 1 (Lab 102, D26)
Week 3	Bioreaction rates and different reactor modes	Kinetic models and modelling	1h/wk Problem-Solving	SuperPro Task 2 and Demonstrate Berkley Madonna (BM) (Lab 102, D26)
Week 4	Oxygen Mass Transfer	Calculations around oxygen transfer, uptake, mixing. Cell Bioreactors	1h/wk Problem-Solving	Wet Lab Introduction
Week 5	Cell bioreactors	**Mid-session Test**	1h/wk Problem-Solving	Wet Lab (Lab 11, E26) Oxygen Mass transfer
Week 6	Enzyme bioreactors	Enzyme Bioreactors Primary Separation Processes	1h/wk Problem-Solving	Wet Lab (Lab 11, E26) Filtration, diafiltration
Week 7	Filtration and Diafiltration	Calculations on cross-flow filtration and diafiltration	1h/wk Problem-Solving	Wet Lab (Lab 11, E26) Cellulose Hydrolysis I
Week 8	Process Chromatography	Calculations for sizing and running chromatography processes	1h/wk Problem-Solving	Wet Lab (Lab 11, E26) Cellulose Hydrolysis II
Week 9	Biotherapeutics processing	The case for single-use bioprocess units. Course Summary	1h/wk Problem-Solving	BABS3631 Lab (Lab 11, E26)
Week 10			1h/wk Problem-Solving	BABS3631 Lab (Lab 11, E26)

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 1: On-line Quiz		0	Online submission by the end of week 3	No mark. Work checked for completion.	3
Summative assessments					
Assessment 1: Assessment on bioprocess kinetics	Questions on selected Tutorial Sets plus some extra questions	12	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Written feedback provided.	8
Assessment 2: Laboratory work	Reports Portfolio	21	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Written feedback provided.	10
Assessment 3: Mid-session Test		25	Written examination conducted during a lecture time in week 5	Solutions gone through in class	5
Assessment 4: Final Exam		42	Written examination conducted during final examination period	Mark/grade release to students on official assessment results release date. Feedback provided upon request.	

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Assessment task and methods		Weighting (%)	Submission methods	Mark and feedback methods	Week due
Formative assessments					
Assessment 1: On-line Quiz		0	Online submission by the end of week 3	No mark. Work checked for completion	3
Summative assessments					
Assessment 1: Assessment on bioprocess kinetics	Questions on selected Tutorial Sets plus some extra questions	10	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Written feedback provided.	8
Assessment 2: Laboratory work	Reports Portfolio	18	Electronic submission via Turnitin in Moodle	Marked by the course convenor. Written feedback provided.	10
Extra Lab Assignment	Report on extra lab work plus questions	10	Direct to course convenor. Work in small groups	Marked by the course convenor. Written feedback provided.	11
Assessment 3: Mid-session Test		22	Written examination conducted during a lecture time in week 5	Solutions gone through in class	5
Assessment 4: Final Exam		40	Written examination conducted during final examination period	Mark/grade release to students on official assessment results release date. Feedback provided upon request.	

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 lectures and on-line material. This will be assessed by written or oral assignments and exams. The other 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).

5.3 Submission of assessment tasks

Assignment submission

Details on assignment submission are given in the course manual or online via Moodle (also please refer to the table provided in section 5.1). For assignments that are to be submitted to the Biosciences Student Office, students are required to attach and complete a cover sheet which is available from both Student Office and online via Moodle.

Information on extension of deadline and penalties for late submission are explained in the course manual.

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.

Further information is provided in the course manual.

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. Readings and resources

Text Books and Course Manuals

This course offers a 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. Students are expected to become fully conversant with the library and all its resources. Tutorials will be given as required in this area. Any extra required readings will be provided on Moodle or in the class. In addition, the course manual is available in print and via Moodle.

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. This site will be used to distribute course notes and information and should be checked at regular intervals. This includes:

- Lecture handouts
- Practical notes - exercise papers
  - online practical
- Tutorial notes
- Assessments - detailed information
  - marks
  - further information resulting from special consideration
- Information about examination arrangements
- 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.

8. Administrative matters

Biosciences Student Office

Student Advisor (BABS)

Email: BABStudent@unsw.edu.au

Tel: +61 (2) 9385 8047

School Contact (*set up in progress*)

Director of Teaching

Email: *BABSteaching@unsw.edu.au*

Faculty Contact

Dr Gavin Edwards

Associate Dean (Academic Programs)

Email: g.edwards@unsw.edu.au

Tel: +61 (2) 9385 4652

Additional Websites

- Biosciences Student Office: https://www.babs.unsw.edu.au/contact/biosciences-student-office
- School of Biotechnology and Biomolecular Sciences website for current students: https://www.babs.unsw.edu.au/current-students/undergraduate-programs
- MyUNSW: https://my.unsw.edu.au/

9. 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.

10. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- 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/
- UNSW Student Equity and Disabilities Unit: https://student.unsw.edu.au/disability
- 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