BIOM9420

Clinical Laboratory Science

Term 2, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Kang Liang	kang.liang@unsw.edu.au	Email confirmation prior face-to-face consultation	SEB E8	

School Contact Information

Student Services can be contacted via unsw.to/webforms.

Course Details

Units of Credit 6

Summary of the Course

BIOM9420 explores the science behind clinical diagnostics covering areas of biochemistry, haematology, immunology, imaging and clinical biomechanics as well as the renal and cardiovascular systems. In each of the areas the underlying principles in the measurement of certain physiological parameters will be covered and how they have been used to engineer diagnostic equipment.

Course Aims

Course Objectives
BIOM9420 Clinical Laboratory Science has been designed to provide students with a taste of some of the many different aspects of clinical medicine where Biomedical Engineers are of fundamental importance for the development of instrumentation to diagnose and monitor diseases. The course is focused on the fundamental science that underlies some of the diagnostic tests and the students are encouraged to explore how Biomedical Engineers have taken these fundamentals and made them work within a diagnostic laboratory environment. The course will cover the technologies, tests and operation of a variety of clinical laboratory testing systems (biochemistry, haematology and immunology) and how they apply to a particular organ or system. The students will also be exposed to the underlying principles involved in the measurement of certain physiological parameters from some of the complex organ systems including the urinary, cardiac and gastro-intestinal systems. An important component of the course is two practical sessions. The first focuses on the fundamentals of enzyme biochemistry and how this might be useful in generating a test for a particular disease and the second will build upon this knowledge to design, fabricate and test a diagnostic test strip for glucose.
Aims of the Course
- To enable students to experience different aspects of engineering in clinical laboratory testing systems relevant to biomedical engineers.
- To introduce students to the concept of variability in medicine and biology.
- To develop problem solving skills for the medical field.
- To contextualise the learning

Course Learning Outcomes

1. Identify the underlying scientific and engineering principles of a variety of clinical testing and/or diagnostic systems
2. Apply problem-solving skills to a variety of case studies in the medical field
3. Demonstrate teamwork skills and reflect upon their own strengths and weaknesses while collaborating with others in a team environment
4. Produce a scientific report that includes a literature review relevant to a clinical laboratory device or diagnostic tool

EXPECTED LEARNING OUTCOMES

On completion of this course, the student should:

- Identify the underlying scientific and engineering principles of a variety of clinical testing and/or diagnostic systems
- Apply problem-solving skills to a variety of case studies from the medical field.
- Demonstrate teamwork skills and reflect on individual strengths through collaborating with others in a team environment.
- Produce a scientific report and a literature review relevant to a clinical laboratory device or diagnostic.

These learning outcomes will be achieved through maximal participation in area of the structured teaching strategies provided in class time (on-line lectures and activities) as well as student-centred and self-directed learning (private study and completion of assessment tasks)

Teaching Strategies

Please refer to the information in Moodle

Assessment

Assignments must be submitted via Moodle by the designated date and time. The Report must contain a **Non Plagiarism Declaration Cover Sheet**

Late submissions will be penalised 5% of the mark for each calendar day late, capped at five days (120 hours), after which a student cannot submit and assessment, and no permitted variation. If you foresee a problem in meeting the nominated submission date, please contact the Course Convenor to discuss your situation as soon as possible.

Assessment marks will be available on Moodle as soon as possible after marking, which will normally be within 2 weeks of submission.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Enzyme Activity Assessment – "marble" practical	10%	Friday, Week 5	1, 2, 3, 4
2. Online Mid-term Quiz	10%	At the end of tutorial on Week 7	1, 2
3. Rapid antigen test strip design report	10%	Friday, Week 8	1, 2, 3, 4
4. Major Group Report	20%	Friday, Week 10	1, 2, 3, 4
5. Group video presentation	15%	Sunday, Week 9	1, 2, 3, 4
6. Final Exam	35%	Not Applicable	

Assessment 1: Enzyme Activity Assessment – "marble" practical

Due date: Friday, Week 5

In this activity we will use marbles to explore Michaelis-Menten enzyme kinetics where your (or their) hands are the enzymes and the marbles are the substrates. The data collected by you (or them) will be used to complete the assessment task.

The objectives of this activity are to:

1. Demonstrate the principles of enzyme kinetics.
2. Become familiar with the theory of Michaelis-Menten kinetics and its relevance for Biomedical Engineers.
3. Present and analyse experimental data.

Assessment 2: Online Mid-term Quiz

Due date: At the end of tutorial on Week 7

The Online Mid-term Quiz is designed to reflect on the learning of the first few weeks and to encourage review of the course content up to the mid-term flexible week. It will also prepare students for the types of questions and how these are run on Moodle in preparation for the final exam.

Assessment 3: Rapid antigen test strip design report

Due date: Friday, Week 8

Rapid antigen test strip design report (10%) is a group task designed to enhance students understanding in relevant topics and apply the knowledge in timely clinical and diagnostic settings.

Assessment 4: Major Group Report

Due date: Friday, Week 10

Major Group Report is completed as a group-based literature review task designed to provide an opportunity for team-work and independent literature searching on different complementary topic areas relevant to the non-invasive diagnostics in a clinical setting.

Assessment 5: Group video presentation

Due date: Sunday, Week 9

Group video presentation is a group-based activity designed to consolidate learning in the assessments and tutorials and bring it all together in a team environment to produce a cohesive and balanced short video presentation.

Assessment 6: Final Exam

The Final Exam includes two parts- (1) Final Online Quiz (similar to the mid-term quiz, 10%) + Time-limited, open-book, long-answer questions (requires Moodle upload, 25%)

Course Schedule

Week	Date	Live Event Lecture	Online Resources	Tutorial	Assessment Due
1	29 May	**Diagnostic Engineering 1** **Course introduction** *Biomedical Engineering and Diagnostics*	1. MATLAB introduction – Onramp course 1. Background to group major report - Glucose Biosensors 1. Cell & DNA background for week 3	**Workshop 1** – Complete MATLAB Onramp course	Append MATLAB Course Completion Certificate to the Enzyme activity report in week 5
2	5 Jun	**Diagnostic Engineering 2** *Blood Diagnostics* *Antibody-based Diagnostics*	1. Cell cycle video 1. Exercise on cell cycle 1. Review Enzyme Kinetics Activity Risk Assessment	**Workshop 2** – Group discussion on sources of scientific literature. Compare reviews, journals & scientific reports Write an abstract	

			& Quiz 2. Introduction to diagnostics - enzymes 1. PCR virtual lab		
3	12 Jun	**Diagnostic Engineering 3** (*Public Holiday, no F2F lecture*) *DNA, Genetics & PCR Diagnostics*	1. Chromosomal disorders 1. Single gene Inheritance	**Workshop 3** – Enzyme Kinetics Activity - Moodle “Marble” practical	
4	19 Jun	**Diagnostic Engineering 4** *Cardiac Monitoring*	1. Genetic testing 1. Worked example - cardiac output 1. Worked example - dilution	**Workshop 4** – Cardiac Monitoring -exercise	
5	26 Jun	**Diagnostic Engineering 5** *Kidney Function*	1. Worked example - ECG 1. Urinary system 1. Glomerular filtration	**Workshop 5** – Rapid antigen test strip design	**Enzyme Kinetics Activity Report** Due Friday week 5

			1. Diagnosis of type 2 diabetes	Group discussion on how to write a literature review	
6		**Flexible Week**	Group video and major report Q&A 1. Gait video practice		
7	10 Jul	**Diagnostic Engineering 7** *Clinical Gait Analysis (online module, no F2F lecture)*		Quiz 1 – on-line (open book)	**Quiz 1** Due at end of tutorial time
8	17 Jul	**Diagnostic Engineering 8** *Imaging Modalities*	1. Imaging tutorial questions	**Workshop 8** – Group discussion & presentation on imaging tutorial question	**Rapid antigen test strip design report** Due Friday Week 8
9	24 Jul	**Diagnostic Engineering 9** *Lung Function*	Group video and major report Q&A 1. 3D lung model 1. Spirometry and Peak Flow Test	**Workshop 9** – Group discussion and report back on gait function exercise	**Group Video** Due Sunday Week 9
10	31 Jul	**Review of content** (*No F2F lecture*)		**Group video presentations**	**Major Group Report** Due Friday week

View class timetable

Timetable

Date	Type	Content
O-Week: 22 May - 26 May		
Week 1: 29 May - 2 June	Lecture	**Diagnostic Engineering 1** **Course introduction** *Biomedical Engineering and Diagnostics*
	Online Activity	1. MATLAB introduction – Onramp course 2. Background to group major report - Glucose Biosensors
	Tutorial	**Workshop 1** – Complete MATLAB Onramp course
	Assessment	Append MATLAB Course Completion Certificate to the Enzyme activity report in week 5
Week 2: 5 June - 9 June	Lecture	**Diagnostic Engineering 2** *Blood Diagnostics* *Antibody-based Diagnostics*
	Online Activity	1. Ovulation test strip design 2. Cell & DNA background for week 3 3. Cell cycle video 4. Exercise on cell cycle 5. Review Enzyme Kinetics Activity Risk Assessment & Quiz 6. Introduction to diagnostics - enzymes
	Tutorial	**Workshop 2** – Group discussion on sources of scientific literature. Compare reviews, journals & scientific reports Write an abstract
Week 3: 12 June - 16 June	Lecture	**Diagnostic Engineering 3** (Public Holiday, no F2F lecture, Video recording will be posted on Moodle)

		DNA, Genetics & PCR Diagnostics
	Online Activity	1. PCR virtual lab 2. Chromosomal disorders 3. Single gene Inheritance 4. Genetic testing
	Tutorial	**Workshop 3** – Enzyme Kinetics Activity - Moodle “Marble” practical
Week 4: 19 June - 23 June	Lecture	**Diagnostic Engineering 4** *Cardiac Monitoring*
	Online Activity	1. Worked example - cardiac output 2. Worked example - dilution 3. Worked example - ECG
	Tutorial	**Workshop 4** – Cardiac Monitoring exercise
Week 5: 26 June - 30 June	Lecture	**Diagnostic Engineering 5** *Kidney Function*
	Online Activity	1. Urinary system 2. Glomerular filtration 3. Diagnosis of type 2 diabetes
	Tutorial	**Workshop 5** – Rapid antigen test strip design Group discussion on how to write a literature review
	Assessment	**Enzyme Kinetics Activity Report** Due Friday week 5
Week 7: 10 July - 14 July	Lecture	**Diagnostic Engineering 7** *Clinical Gait Analysis (online module, no F2F lecture)*
	Online Activity	1. Gait video practice
	Tutorial	Quiz 1 – on-line (open book)

	Assessment	**Quiz 1** Due at end of tutorial time
Week 8: 17 July - 21 July	Lecture	**Diagnostic Engineering 8** *Imaging Modalities*
	Online Activity	1. Imaging tutorial questions
	Tutorial	**Workshop 8** – Group discussion & presentation on imaging tutorial question Group video and major report Q&A
	Assessment	**Rapid antigen test strip design report** Due Friday Week 8
Week 9: 24 July - 28 July	Lecture	**Diagnostic Engineering 9** *Lung Function*
	Online Activity	1. 3D lung model 2. Spirometry and Peak Flow Test
	Tutorial	**Workshop 9** – Group discussion and report back on gait function exercise
	Assessment	**Group Video** Due Sunday Week 9
Week 10: 31 July - 4 August	Lecture	**Review of content** (*No F2F lecture*)
	Tutorial	**Group video presentations**
	Assessment	**Major Group Report** Due Friday week 10

Resources

Recommended Resources

RELEVANT RESOURCES – Useful Books

- Introduction to Biomedical Engineering (3rd edition) by John Enderle and Joseph Bronzino Publisher: Elsevier/Academic Press, 2011, ISBN: 9780123749796

Digital available - **https://unswbookshop.vitalsource.com/products/-v9780080961217**

- An Introduction to Clinical Laboratory Science by Connie Mahon, Linda A. Smith and Cheryl Burns. Publisher: Elsevier Health Sciences, 1988, ISBN10 0721649904

Course Evaluation and Development

Student feedback has helped to shape and develop this course, including feedback obtained from on-line evaluations as part of UNSW's myExperience process. Changes to the course have included revision to the course content by refocusing on the lecture content and balancing this content across the sciences and maths. This course is now designed to run on-line in distance mode.

Submission of Assessment Tasks

Laboratory reports and major assignments will require a Non Plagiarism Declaration Cover Sheet.

Assignments should be submitted on time. A daily penalty of 5% of the marks available for that assignment will apply for work received after the due date. Any assignment more than 5 days late will not be accepted. The only exemption will be when prior permission for late submission has been granted by the Course coordinator. Extensions will be granted only on medical or compassionate grounds under extreme circumstances.

Academic Honesty and Plagiarism

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0?il, and students who plagiarise may fail the course. Students who plagiarise will have their names entered on a plagiarism register and will be liable to disciplinary action, including exclusion from enrolment.

It is expected that all students must at all times submit their own work for assessment. Submitting the work or ideas of someone else without clearly acknowledging the source of borrowed material or ideas is plagiarism.

All assessments which you hand in must have a Non Plagiarism Declaration Cover Sheet. This is for both individual and group work. Attach it to your assignment before submitting it to the Course Coordinator or at the School Office.

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 Information

COURSE EVALUATION AND DEVELOPMENT

Student feedback has helped to shape and develop this course, including feedback obtained from on-line evaluations as part of UNSW's as part of UNSW's myExperience process. You are highly encouraged to complete such an on-line evaluation toward the end of Term. Feedback and suggestions provided will be important in improving the course for future students.

DATES TO NOTE

Refer to MyUNSW for Important Dates, available at:
https://my.unsw.edu.au/student/resources/KeyDates.html

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS

refer to the School website available at
http://www.engineering.unsw.edu.au/biomedical-engineering/

Supplementary Examinations:

Supplementary Examinations for Term 2 2023 will be held on (TBC) should you be required to sit one.

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.