School of Engineering

MENG3100: Biomaterials and BioFluids

Callaghan
Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

Fluids within the human body are more complex than those studied in general fluid mechanics. Through this course students will gain a deeper appreciation of those complexities and methods for their analysis. A range of biological fluid process phenomena such as pulsating flows, viscosity changes vis a vis shear rates and diffusion processes of gases/liquids will be presented enabling students to discuss these complexities across different professional boundaries.

Natural biomaterials have a set of properties that are both complex and diverse requiring a level of knowledge before embarking on interfacing synthetic elements either internally or externally.

Students will examine a range of different natural and synthetic material properties to build a robust working knowledge in this area. By developing this engineering appreciation of both synthetic and biological materials in the context of bio applications and compatibilities, students will be better positioned to contribute to the design of external and internal prosthesis.

Academic Progress Requirements

Nil

Contact Hours

Callaghan
Integrated Learning Session
Face to Face On Campus
2 hour(s) per week(s) for 12 week(s) starting Week 1
Topic area on Weekly alternating schedule.

Lecture
Face to Face On Campus
2 hour(s) per week(s) for 12 week(s) starting Week 1

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 Behnam Akhavan
Behnam.Akhavan@newcastle.edu.au
(02) 4033 9246
Consultation: Tuesday 3:30 pm - 4:30 pm

Teaching Staff

Dr Changyan He
changyan.he@newcastle.edu.au
(02) 4055 0264

School Office

School of Engineering
EAG02
EA Building
Callaghan
+61 2 4921 5798
9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

SYLLABUS

Course Content

Biofluids:

1. Review of Fluid Mechanics Principles
2. The Heart
3. Arteries and Veins
4. Microvascular Circulation
5. The Lungs
6. Joint Lubrication
7. Computational Fluid Mechanics (CFD)

Biomaterials:

1. Introduction to Biomaterials
2. Types of Biomaterials
3. Mechanical Properties of Biomaterials
4. Implants and Prostheses
5. Tissue Engineering

Course Learning Outcomes

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

1. Discuss the complexity and differences of biofluids in comparison to simple fluids.
2. Evaluate different materials for specific internal and external use situations.
3. Explain different manufacturing processes relating to synthetic materials.
4. Apply Computational Fluid Dynamics principles and practices to a relevant clinical problem.

Course Materials

Recommended Text:

- Software (provided free of charge by the University of Newcastle):
  ANSYS Workbench
  ANSYS (CES) Granta EduPack

Reference Texts:

1. Frame, M.D., Yin, W., Rubenstein, D., (2021), Biofluid Mechanics: An Introduction to Fluid Mechanics, Macrocirculation, and Microcirculation, Netherlands, Elsevier Science.
2. Fare, S., Tanzi, M., Candiani, G. (2019), Foundations of Biomaterials Engineering, Netherlands, Elsevier Science.
3. Mechanical Behavior of Biomaterials, (2019), United Kingdom, Elsevier Science.
4. Biomaterials in Tissue Engineering and Regenerative Medicine: From Basic Concepts to State of the Art Approaches, (2021), Germany, Springer Singapore.

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Biomaterials Report and Presentation	Report: Week 6 (Friday) Presentation: Week 7 Lecture	Group	30%	2, 3
2	Biomaterials and Biofluids Quiz	Week 8 Lecture	Individual	10%	1, 2, 3
3	Project - A	Week 11 (Friday)	Individual	20%	1, 2, 3
4	Project - B	Week 13 (Friday)	Individual	40%	1, 2, 3, 4

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 - Biomaterials Report and Presentation

Assessment Type Report
Description In groups of 3-4, perform materials selection and select suitable manufacturing processes for an implant or prosthetic device of your group's choosing, and illustrate/articulate them in a report and a group presentation. The chosen implant or prosthetic device should be of an appropriate complexity (lecturer's approval) to be suitable for the group size.
Weighting 30%
Due Date Report: Week 6 (Friday)
Presentation: Week 7 Lecture
Submission Method In Class
Online
Report: Online on Canvas
Presentation: In-Class Presentation (Week 7)
Assessment Criteria Provided on the Assessment Brief
Return Method Online
Feedback Provided Online
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Biomaterials and Biofluids Quiz

Assessment Type Quiz
Description A quiz testing knowledge of biomaterials and biofluids principles studied in class.
Weighting 10%
Due Date Week 8 Lecture
Submission Method In Class
Assessment Criteria Correct Answers
Return Method In Class
Feedback Provided
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Project - A

Assessment Type Report
Description The report involves a clinical case study with an aim to demonstrate an understanding of biomaterials and biofluids principles. The report may also involve a discussion on current implantable medical devices.
Weighting 20%
Due Date Week 11 (Friday)
Submission Method Online
Assessment Criteria Provided on the Assessment Brief
Return Method Online
Feedback Provided Online
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - Project - B

Assessment Type Report
Description A report that allows you to demonstrate most of the skills which you have gained over the semester on biomaterials and biofluids concepts.
Weighting 40%
Due Date Week 13 (Friday)
Submission Method Online
Assessment Criteria Provided on the Assessment Brief
Return Method Online
Feedback Provided Online
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

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).

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: 1. the assessment item is a major assessment item; or 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; 3. you are requesting a change of placement; or 4. the course has a compulsory attendance requirement. Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at: 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.

This course outline was approved by the Head of School on 30.01.2024. 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.

Graduate Profile Statements – MENG3100 – S1 2024

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	☑	☑	☑	4
12	3.2. Effective oral and written communication in professional and lay domains.			☑	4
13	3.3. Creative, innovative and pro-active demeanour.			☑	4
14	3.4. Professional use and management of information.				
15	3.5. Orderly management of self, and professional conduct.			☑	4
16	3.6. Effective team membership and team leadership.				
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.	☑	☑	☑	4
8	2.2. Fluent application of engineering techniques, tools and resources.	☑	☑	☑	4
9	2.3. Application of systematic engineering synthesis and design processes.	☑	☑	☑	4
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.	☑	☑	☑	4
	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.	☑	☑	☑	4
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	☑	☑	☑	4
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	☑	☑	☑	4
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.	☑	☑	☑	3
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.	☑	☑	☑	3