Academic Year	2022/23	**Semester**	1
Course Coordinator	Teoh Swee Hin		
Course Code	MS7074		
Course Title	Designing Materials for Biomedical Engineering		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39		
Proposal Date	2 Mar 2022		
Suggested Class Size	30		

Course Aims

The goal of course is to educate students in how to apply fundamental materials science and engineering principles to solve challenging problems in medical devices. Biomaterials such as titanium, polyethylene and bioglass have been used successfully in many medical devices. However, problems such as biocompabtibility, wear, fatigue fracture and tissue irritability still exist. This module exposed students to various problems in biomaterials used in applications such as in orthopedic and cardiovascular surgery. Major controversial issues in the application of biomaterials to medical problems will therefore be covered. Fundamental structure-property relationships and issues such as wear and structural integrity will be addressed. Subjects considered include introduction to biomaterials, host-tissue response, blood compatibility, control drug release polymers, bioadhesion, biodegradation, protein adsorption, corrosion, orthopaedic and cardiovascular implants, stress shielding, materials selection in artificial organs and medical device regulation. Format will utilize case studies, discussion, literature research and problem base learning techniques.

Students gain an appreciation of multidisciplinary approach to problem solving Problem base learning will be used to enhance the learning out come in small groups.

Intended Learning Outcomes (ILO)

By the end of this course, you should be able to:

1. apply fundamental materials science and engineering principles to solve challenging problems in biomedical engineering.
2. Gain the knowledge of the various classifications of engineering materials for implant applications
3. understand host-tissue response
4. understand the failure mechanisms such as corrosion, fatigue, wear and fracture of medical implants
5. understand the requirements of biomaterials eg biocompatibility, manufacturability and sterilizability and regulatory
6. Describe the principles of tissue engineering and how to bring research to clinics and commercialisation

Course Content

1. Introduction to biomaterials and applications (Week 1)
2. Biological materials (Week 2)

3. Cells and blood (Week 3)
4. Metallic implant materials (Week 4)
5. Polymeric implant materials (Week 5)
6. Ceramic implant materials (Week 6)
7. Composite implant materials (Week 7)
   (Recess Week)
8. Quiz 1/PBL discussion in small gps (Week 8)
9. PBL Discussion (Week 9)
10. PBL discussion (Week 10)
11. PBL discussion (Week 11)
12. PBL symposium (Week 12)
13. Quiz 2 (Week 13)

Assessment (includes both continuous and summative assessment)

Note: It is advised that Group component and class participation should not be more than 40% and 20% respectively, unless with good justification.

Component	ILO Tested	Weighting	Team/Individual	Assessment Rubrics
1. Continuous Assessment 1 (CA1): Part 1 Quiz	1, 2,3	25%	Individual	Appendix 1
2. Continuous Assessment 2 (CA2): Part 2 Quiz	4, 5, 6	25%	Individual	Appendix 1
3. Project Presentation	1, 2, 3, 4, 5, 6	30%	Team	Appendix 2
4. Self and Peer Evaluation	1, 2, 3, 4, 5, 6	10%	Individual	Appendix 3
5. Class Participation	1, 2, 3, 4, 5, 6	10%	Individual	Appendix 4
Total		100%		

Note: For class participation, students will be assessed on their participation in class discussions, online quizzes, online discussion, and showing of initiative in class activities.

Formative feedback

In the lecture section, lecturers will answer the questions in class or on zoom live.
For the Quiz, the lecturer will explain the tested points.
For the Peer-Evaluation, selected descriptive comments will be provided to students.
For the problem-based learning, the lecturer will explain the difficult points related to the problem and answer your questions, either right after the class, during the online discussion, or via email.

Learning and Teaching Approach

Note: Please include and indicate TEL component.

Approach	How does this approach support you in achieving the learning outcomes?
Class-room lecture	The class-room lecture will deliver the key points for the learning and explain the related knowledge points by using real-world example and real application. Course materials used in the class cover all the knowledge points that are required for your learning. (COVID19 alternative: live lecture via zoom)
Technology-enhanced learning (TEL)	1. TEL will provide cartoons or videos to facilitate your understanding. 2. Design online learning materials to facilitate your learning. Online materials will be highly relevant to lectures that are delivered in class.
Problem-based learning (PBL)	Real-world related problems will be provided to exercise the knowledge integration, promote critical thinking, and sharpen problem-solving skills. Problem sets will be assigned to groups for collaborative study and presentation. Classroom / online discussion sessions on PBL questions and related topics will be organised to facilitate the learning and sharing between students. (COVID19 alternative: online zoom session and / or small group meet-up).

Reading and References

1. S.H. Teoh (ed) Engineering materials for biomedical applications, World Scientific Pub, . 2004
2. R. Lanza, R. Langer, J. Vacanti, A. Atala (Eds), Principles in Tissue Engineering, 5th edition Elsevier Science Publishing Co Inc, US, April 2020

Course Policies and Student Responsibilities

General: Students are expected to complete all class activities and take all scheduled discussion and presentations and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements. Students are expected to participate in all class discussions and activities.

Continuous assessments: Students are required to attend all continuous assessments.

Absenteeism: Continuous assessments make the whole students' course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect students' overall course grade.

PBL: All the students are required to join the assigned group and participate in the group discussion and presentation. Each student should submit both self-evaluation and the peer evaluation for their groupmates. Feedback and questions provided to other groups will also be recorded and evaluated as part of class participation.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a

set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Teoh Swee Hin	N/A	N/A	teohsh@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
1	Introduction to biomaterials and applications	1,2,5	Lecture and in video tutorials
2	Biological materials	1,3	Lecture and in video tutorials
3	Cells and blood	1,3	Lecture and in video tutorials
4	Metallic implant materials	1,2,3,4,5	Lecture and in video tutorials
5	Polymeric implant materials	1,2,3,4,5	Lecture and in video tutorials
6	Ceramic implant materials	1,2,3,4,5	Lecture and in video tutorials
7	Composite implant materials	1,2,3,4,5	Lecture and in video tutorials
8	Quiz 1/PBL assignment	-	-
9	PBL Discussion	1,2,3,4,5,6	Lecture and in video tutorials
10	PBL Discussion	1,2,3,4,5,6	Lecture and in video tutorials
11	PBL discussion	1,2,3,4,5,6	Lecture and in video tutorials
12	PBL symposium	1,2,3,4,5,6	Lecture and in video tutorials
13	Quiz 2	-	-