

MS4610 – Advanced Biomaterials

Course Code	MS4610				
Course Title	Advanced Biomaterials				
Pre-requisites	MS3011	Metallic & Ceramic Materials			
	MS4013	Biomaterials			
Pre-requisite for	NIL				
No of AUs	3				
Contact Hours	LECTURES	26	Tutorial	13	

Course Aims

This prescribed elective course, built on the core MS4013 Biomaterials course, aims to deepen your understanding of the functional performance of biomaterials. The course will equip you with key knowledge on structure and properties of several advanced biomaterials (biodegradable polymers, medical ceramics and composites) and their applications in medicine. It also introduces various techniques to modify the surface of biomaterials to improve their biocompatibility with host tissues. All of this knowledge is essential for students who wish to specialize in medical materials or pursue a career in the biomedical industry.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. Explain the chemical and physical degradation mechanisms of various synthetic polymers
2. Classify any given biodegradable polymers into bulk-degrading or surface-eroding groups
3. Calculate the hydrolysis rate of polymers that degrade by random scission or by chain-end scission
4. Predict how various polymer-intrinsic factors and external/environmental factors affect the biodegradation rate of polymers
5. Describe the limitations of conventional drug delivery via oral tablets/capsules
6. Illustrate the critical roles of polymers in controlled drug delivery
7. Explain the working principles behind different types of drug delivery systems
8. Demonstrate that bone matrix is a natural composite biomaterials
9. Explain bone remodelling process and stress shielding effect on bone caused by implants
10. Distinguish the host tissues' responses to three different classes of medical

ceramics, namely bioinert, bioactive and biodegradable ceramics

11. Relate the structure and properties of commonly used bioinert, bioactive and biodegradable ceramics to their applications in medicine, particularly as artificial joints, dental implants, bone cements and coatings on orthopaedic implants.
12. Select an appropriate in-vitro test to measure the index of bioactivity and interfacial bond strength of a given bioactive ceramic
13. Use the ternary phase diagram of bioglass to estimate the index of bioactivity of any bioglasses with varying compositions
14. Explain the importance of surface modification of biomaterials and its essential role on biocompatibility
15. Select appropriate techniques to modify the surface of various classes of biomaterials without altering their underlying bulk properties

Course Content

- Biodegradable polymers
- Advanced medical ceramics
- Composites biomaterials
- Applications of biomaterials in medicine
- Surface modification of biomaterials

Reading and References

1. Temenoff, Biomaterials: The intersection of biology and materials science, Pearson, 1st Edition
2. L.L.Hench, J. Wilson, An Introduction to Bioceramics, World Scientific, 1993.
3. B.D. Ratner, A.S. Hoffman, F.J. Schoen, J.E. Lemons, Biomaterials Science: An Introduction to Materials in Medicine, 3rd Edition, Academic Press, 2013

Course Policies and Student Responsibilities

(1) CA

Absentees must be supported by a medical certificate or other valid official documents.

Academic Integrity

Good academic work depends on honesty and ethical behavior. Quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honor 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 of NTU, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at the University. 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, and 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.