Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Adjunct Professor Subramanian Venkatraman
Course Author Email	ASSubbu@ntu.edu.sg
Course Title	Nanobiomaterials
Course Code	MS6016
Academic Units	2
Contact Hours	26
Research Experience Components	

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course covers the fundamental structure-property relationships in polymeric biomaterials, including polymer-tissue interactions. It will focus on applications of polymeric biomaterials in drug and gene delivery; tissue engineering; and nanomedicine including its use in vaccines. It covers advances in various polymer classes, from bio-inert to bioactive to biomimetic polymers.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Understand the various types of nanoparticles and their unique characteristics.
ILO 2	Evaluate the various medical needs being addressed by nanoparticles.
ILO 3	Introduction to Nanodiagnostics.
ILO 4	Critically examine nanoparticle contribution to in vitro diagnostics, and their use as “point-of-care” devices.
ILO 5	Evaluate the use of nanoparticles in in vivo imaging for early detection and treatment.
ILO 6	Understand the need for non-viral gene carriers, and the critical role played by Nanobiomaterials in gene therapy.
ILO 7	Biocompatibility and biodistribution are two important features of nanoparticles: understand how to apply this knowledge for maximizing personalized medicine effects.

Course Content

The following topics will be covered in the course:

1. History of Nanomedicine and the role of biomaterials
2. The interactions of Nanobiomaterials with human tissues
3. Biocompatibility and Biodistribution of Nanomaterials
4. Carbon nanotubes/graphene/ graphene oxides
5. Magnetic nanoparticles and their uses
6. Quantum dots
7. In vitro diagnostics and in vivo imaging using nanoparticles
8. Gene therapy and Vaccines: the role of Nanomaterials
9. Case studies of ocular and cancer nanotherapeutics: the concept of “personalized” medicine
10. Safety aspects of nanomaterial use

Reading and References (if applicable)

- Understanding Nanomedicine, Burgess, Pan Stanford, 2012 (this will be used as a general reference).
- Review papers in Nanodiagnostics and Nanotherapeutics.

Note: The above listing comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they become available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to Nanobiomaterials	1-3	N/A	In-person	Lecture (2 hr)
2	Classes of Nanobiomaterials: Organic, Inorganic, Magnetic (Part 1)	1-3	Understanding Nanomedicine, Chapter 1	In-person	Lecture (2 hr)
3	Classes of Nanobiomaterials: Organic, Inorganic, Magnetic (Part 2)	1-3	Understanding Nanomedicine, Chapter 1	In-person	Lecture (2 hr)
4	Graphene, Graphene Oxide, CNTs	1-3	Review paper	In-person	Guest Lecture 1 (Professor Barbaros Özyilmaz, Department of Materials Science and Engineering, NUS) (2 hr)
5	Magnetic Biomaterials, Quantum Dots and Gold NPs	1-3	N/A	In-person	Lecture (2 hr)
6	Nano-Diagnostics: In vitro	3-4	Understanding Nanomedicine, Chapter 8	In-person	Lecture (2 hr)
7	Continual Assessment 1 (CA1): Individual Mid-Term Quiz	1,2,3, 4	N/A	In-person	Continual Assessment 1 (CA1): Individual Mid-Term Quiz (1 hr)
8	Review of Continual Assessment 1 (CA1): Individual Mid-Term Quiz	1,2,3, 4	N/A	In-person	Review of Continual Assessment 1 (CA1): Individual Mid-Term Quiz (1 hr)
9	In vitro (Point-of-Care) Diagnostics	3,4,5	Review article 1	In-person	Guest Lecture 2 (Dr Kate Qi, SG Diagnostics) (2 hr)

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
10	Nanoimaging Concepts	3,4,5	Review article 2	In-person	Guest Lecture 3 (Professor Ann-Marie Chacko, Duke-NUS Medical School) (2 hr)
11	Nanomedicine: Gene Delivery Fundamentals, including Covid-19 Vaccines	6-7	Review article 3	In-person	Lecture (2 hr)
12	Cancer and Ocular Applications of Gene Delivery	6-7	Review article 4	In-person	Lecture (2 hr)
13	Oral Insulin, Nanofunctionalization	6-7	Review article 5	In-person	Lecture (2 hr)
14	Consultation and Submission of Continual Assessment 2 (CA2): Group Written Report	5,6,7	N/A	In-person	Consultation and Submission of Continual Assessment 2 (CA2): Group Written Report (2 hr)

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Blended learning with active use of multi-media resources (TEL)	This will permit flexibility of access to learning materials, activities and assessments and can help you develop independent learning and critical thinking skills.
Showing real-world applications	Concepts and features of polymers discussed here are related to their performance in applications in medicine. Case studies will put the role of polymers in medicine, in context.
Weekly Consultation	Weekly consultation hours will be available to encourage discussions that will reinforce students' understanding on various concepts and applications. Instead of providing answers directly to students' queries, they will be guided to think and make intelligent guesses based on sound principles. This approach will cultivate critical thinking.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Continual Assessment 1 (CA1): Individual Mid-Term Quiz)	1,2,3,4		60	The assessment will test the students' grasp of concepts and applications. Duration: 1.5 hours; MCQ and short-answer questions; about 15-20 questions.	Individual	Holistic	Multistructural
2	Continuous Assessment (CA): Report/Case study(Continuous Assessment 2 (CA2): Group Written Report)	5,6,7		40	Group written report on Nanodiagnostic or Nanotherapeutic product involving the use of a Nanobiomaterial. Each member will be given a section to work on. 10-12 teams total.	Team	Holistic	Relational

Description of Assessment Components (if applicable)

Formative Feedback

- In-video tutorial classes and discussions / feedback during group presentations
- Grading and general feedback after each CA.
- You are encouraged to drop by coordinator's office during the consultation hours to browse through your papers and discuss any issues, if needed.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Collaboration	Intermediate
Curiosity	Intermediate
Problem Solving	Advanced
Transdisciplinarity	Advanced
Critical Thinking	Intermediate

Course Policy

Policy (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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

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