Annex A

1. GE NEW COURSE CONTENT

Academic Year	AY2023-2024	**Semester**	1
School/Programme	School of Materials Science and Engineering Doctor of Philosophy (MSE)		
Course Coordinator	Dr Luciana Lisa Lao		
Course Code	MS7470		
Course Title	Nanostructured Materials for Healthcare		
Pre-requisites	N/A		
No of AUs	2		
Contact Hours	26		
Proposal Date	28 September 2022		
Expected Implementation date of new/revised course	AY2023-2024 Semester 1		
Suggested Class Size	30		
Any cross-listing? ***Is course opened to all Postgraduate students (including IGP) or specific program (please indicate)?***	Master of Engineering (MSE) Master of Science (MSE) Doctor of Philosophy (IGP) Students from the above-stated programmes are not required to seek approval from MSE to be registered for the course.		

Course Aims
This course will introduce you to interdisciplinary field of nanostructured materials, particularly self-assembled nano-biomaterials. First, you will learn about self-assembly processes of micelles, bilayers, liposomes, Langmuir-Blodgett films, self-assembled monolayers and more. Next, you will learn about the applications of such nanostructured materials in the field of healthcare and cosmetics, such as nanotherapeutics, cancer therapy, nanocarriers for cosmetic ingredients, etc. Students who are working in the field of biomaterials/nanotechnology will find the course useful. Others who like to expand their knowledge or venture into this emerging interdisciplinary field will find the course informative too.
Intended Learning Outcomes (ILO)
By the end of this course, you should be able to: 1. Define self-assembly as a process of constructing materials atom by atom or molecule by molecule 2. Apply the principle of self-assembly to create various nanostructures 3. Explain how micelles are formed through self-assembly of their building blocks. 4. Describe the important parameters that define micelles. 5. Illustrate the formation of bilayers and its differences from micelles. 6. Describe other structural bilayers such as vesicles, liposomes and niosomes. 7. Discuss the formation of liposomes and their main features. 8. Explain self-assembly process at interface that lead to the formation of nanostructured films such as Langmuir-Blodgett (LB) films and Self Assembled Monolayers (SAM). 9. Discuss the application of nanostructured materials in cosmetics as sunscreen, nanocarriers for delivery in cosmetics and more. 10. Discuss the application of nanostructured materials in healthcare, particularly as nanotherapeutics

11. Apply the concept of active and passive targeting in cancer nanotherapeutics.

Course Content

- Introduction (key concepts, self-assembly, examples of self-assembly in nature)
- Self-assembled nanostructured materials (micelles, bilayers, liposomes, Langmuir-Blodgett films, Self-Assembled Monolayers (SAM))
- Applications of nanostructure materials in cosmetics and healthcare (sunscreen, nanocarriers for cosmetic delivery, nanotherapeutics, nanocarriers for cancer treatment, antimicrobial use)

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): Group Presentation / Report	1-11	40%	Team	Appendix 1
2. Continuous Assessment 2 (CA2): Class Test	1-11	60%	Individual	N/A
Total		100%		

Formative feedback

- In-video tutorial questions are available so that you can gauge your understanding of the topics discussed. Immediate feedback has been incorporated to guide you to revise a particular concept whenever you provide wrong answers.
- You will be informed of your CA marks after each CA.
- General feedback on common mistakes will be provided 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.

Learning and Teaching Approach

Note: Please include and indicate TEL component.

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	Most of the concepts that are dealt in the course have real-world implications and applications. Therefore, they are used as examples while discussing the related concepts.
Weekly	Weekly consultation hours will be available to encourage discussions that

Consultation	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.

Reading and References

- Self-Assembly and Nanotechnology: A Force Balance Approach, 1st edition, Yoon S. Lee, Wiley, 2008.
- Nanostructures and Nanomaterials – Synthesis, Properties and Applications, 2nd edition, Guozhong Cao, Ying Wang, World Scientific, 2011.
- Nanobiomaterials: Nanostructured Materials for Biomedical Applications, 1st edition, Roger Narayan, Woodhead Publishing, 2017.

Course Policies and Student Responsibilities

(1) General

You are expected to complete all assigned pre-class readings and activities and watch all recorded lecture videos. You are expected to take responsibility to follow up with course notes and course related announcements throughout the semester. You are expected to adhere to the suggested weekly schedule.

(2) Absenteeism from CA

Absence from a class test without a valid reason will affect your overall course 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.

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
Dr Luciana Lisa Lao	N4.1-01-09	65923202	LLLao@ntu.edu.sg

Industry Participation

Company Name	Description of involvement (e.g., co-curation of course, speaker or instructor), include no. of course hours if known.	Contact Person	Email
TBC	Guest speaker(s) from healthcare industry and/or medical practitioners will be invited to share insights on the success and challenges of the application of nanostructured materials for healthcare and therapeutics.	TBC	TBC

Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
1	Introduction – Key concepts and Self-Assembly	1, 2	Lecture and in video tutorials
2	Micelles: Formation and important parameters	2, 3	Lecture and in video tutorials
3	Evolution of Micellar Structures	3, 4	Lecture and in video tutorials
4	Bilayers	5	Lecture and in video tutorials
5	Liposomes – Building blocks and features	6, 7	Lecture and in video tutorials
6	Synthesis of liposomes	6, 7	Lecture and in video tutorials
7	Self-Assembly at Interface	8	Lecture and in video tutorials
8	Applications in cosmetics	9	Lecture and in video tutorials
9	Applications in cosmetics	9	Lecture and in video tutorials
10	Applications in healthcare	10, 11	Lecture and in video tutorials
11	Applications in healthcare	10, 11	Lecture and in video tutorials
12	CA1	1 – 11	N/A
13	CA2	1 – 11	N/A

Appendix 1: Assessment Criteria for <u>Group Presentation/Report</u>

Each student's mark comprises team evaluation (80%) and peer review (20%).

<u>Team Evaluation Rubrics (80%)</u>

Categories	Scoring Criteria	Description	Score (0-10), e.g. 7.3
Content and Analysis (50%)	Problem / Critical Need	The underlying problem or critical need is described clearly. Any technical jargons/terms are well explained.	/10
	Past or Present Engineering / Materials / Technology	Illustration on the past or present engineering solution or technology is provided in details. Analysis of the present materials' properties including physical, mechanical, chemical and surface and biological (if relevant) is discussed. Sample of past or present devices or products are given.	/10
	Limitations of existing solution	Critical analysis on the performance of the past or present device/product/technology. Comments on material-related problems on why and how the devices fail, which material performs best, which material performs worst and why. What are the limitations?	/10
	Use of nano-materials/nanostructured materials	Explain the rationales behind the introduction and use of nanomaterials/technology. What are the benefits and improvements offered by nanotechnology? Provide sample of products/devices. Claims are backed up by solid data. Are there any concerns with the use of nanomaterials? Health issues? Occupational hazards? Environmental damage?	/10
	Next generation materials	Latest research of next-generation material or technology in the device development and/or proposes own new materials for recommendation.	/10
Layout and Presentation (30%)	Language & Delivery	The presentation is understandable with appropriate language level. Topic-specific words/concepts are described and make sense. Speaker uses a clear, audible voice.	/10
	Coherence & Visual aids	Presentation is well organized with clear introduction and conclusion. Information is presented in a logical sequence and flows smoothly. Effective use of visual or multimedia aids that are informative, effective and not distracting	/10
	References	A variety of sources of information with a good mix of reference types, recent and older references is used. All specific information has been properly referenced.	/10
		TOTAL (max 80)	/80

Peer Review Rubrics (20%)

Criteria	Description	Score (0-5), e.g., 3.0 / 3.5		
		Student A	Student B	Student C
Cooperation and Participation	Treated others respectfully and shared the workload fairly. Participated fully in discussions and was always on task.	/5	/5	/5
Time Management	Completed assigned tasks on time to ensure group progressed smoothly according to the planned schedule.	/5	/5	/5
Feedback	Offered detailed, constructive feedback when appropriate and received feedback graciously.	/5	/5	/5
Leadership	Assumed leadership in an appropriate way when necessary by helping the group stay on track, encouraging group participation, posing solutions to problems, and having a positive attitude.	/5	/5	/5
	TOTAL (max 20)	/20	/20	/20