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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2024-2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Leek Meng Lee
Course Author Email	mlleek@ntu.edu.sg
Course Title	Physics in the Industry
Course Code	PH4418
Academic Units	4
Contact Hours	52
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	PH3101 - Quantum Mechanics II and (PH3102 Condensed Matter Physics I or PH3103 Technological Applications of Quantum Mechanics)
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

This course aims to introduce you to a broad range of physics-related industries. On completion of the course, you will appreciate how physics is being applied to a wide range of industries and can make a more informed decision on the industries that better suit your career interests.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Describe key physics principles used in specific industries.
ILO 2	Conduct an investigation into how physics is applied to a chosen industry.
ILO 3	Present the findings from the investigation in the form of a report and a presentation.

Course Content

This course aims to introduce you to a broad range of physics-related industries. On completion of the course, you will appreciate how physics is being applied to a wide range of industries and can make a more informed decision on the industries that better suit your career interests. Examples of industries include the Semiconductor industry, the Photonics industry, the Food Industry, the Biomedical industry and the Photonics industry. These are subjected to changes.

Topics include

- Industry 1: Physics in the Semiconductor Industry
- Industry 2: Physics in the Biomedical Industry
- Industry 3: Physics in the Food Industry
- Industry 4: Physics in the Photonics Industry

Course Outline

S/N	Topic	Lecture Hours	Tutorial Hours

1	Physics in the Semiconductor Industry: This topic has two main sections: 1. Semiconductor integrated circuits devices 2. Semiconductor processing technology Semiconductor integrated circuits devices • CMOS transistor • Memory devices – SRAM, DRAM, Non-volatile memory devices • Scaling of integrated circuit Semiconductor processing technology • Growth of silicon wafer • Physical vapour deposition – sputtering growth • Chemical vapour deposition • Lithography – immersion scanner • Pattern transfer – etching • Doping • Metallisation • Packaging	12	0

2	Physics in the Photonics industry: Working using light spectral property: • Light spectrum and related concepts • Spectrometers and its applications • Hyperspectral Imaging and its applications • New emerging spectral related industries Working using light coherence property: • Light coherence and related concepts • Different classes of lasers • Diode pumped solid state lasers and its applications • Nonlinear optical devices and its applications	12	0

3	Physics in the Food Industry: An overview of soft condensed matter physic will be covered to familiarize students to broad aspects of various industries. Physical systems easily deformable by thermal or mechanical stresses of order of magnitude similar to thermal fluctuations. Attention will be focused on industrial applications rather than academic theoretical research. Topics covered will include • Forces & Energy, Intermolecular forces • Colloids as model systems for soft matter • Colloidal interactions • Phase diagrams • Packing • Self assembly • Complex fluids • Force, pressure & stress • Newtonian & non-Newtonian liquids • Reynolds number • Navier- Stokes • Structure of soft materials • Equilibrium & non-equilibrium • Linear rheology • Flexible polymer • Viscoelasticities	12	0

4	Physics in the Biomedical Industry: 1) Speech, Acoustics and Audiology Overview of voice generation, vocal tract, acoustic modelling of voice and acoustic transmission. Acoustic transmission includes pinna, outer, middle & inner ear acoustics. Further on, the basics of mechanical to electrical nerve stimulation and acoustic path up to the auditory cortex will be introduced. Human speech recognition, e.g. represented by Speech Intelligibility Index (SII), is highly linked to audiology and acoustic perception. Introduction of basic acoustic physics like pressure wave, wave equation, acoustic impedance, sound pressure levels 2) Physics of Middle & Inner Ear Definition of Hearing Threshold, Measurement of Hearing Threshold. Frequency shaping of acoustic path, middle ear impedance matching, inner ear mechanics and nerve stimulation, optoacoustic emissions – modeling concepts and measurement Introduction to basics of time series analysis, data measurement, filtering, FFT & Spectrogram and applications 3) Hearing Aids Basics of hearing aid technology, requirements, technical concepts, advanced signal processing, directional microphones. Manufacturing requirements and challenges. Introduction to basic signal processing techniques, algorithms and tools. 4) Measurement Methods and Hearing Aids Introduction of various measurement techniques for transducers, noise and spatial hearing. Impact of hearing aids on noise, noise perception and spatial hearing. Overview hearing aid industry: Manufacturer, Suppliers, Clinics and Audiologists.	12	0
5	Research on the application of Physics in an industry and write a report and give a presentation	4	

Reading and References (if applicable)

1. Semiconductor Manufacturing Technology by Michael Quirk and Julian Serda (2000) ISBN-13: 978-0130815200

2. Optoelectronics & Photonics: Principles & Practices (2nd Edition) by Safa O. Kasap (2012) ISBN-13: 978-0132151498

3. Soft Condensed Matter (Oxford Master Series in Condensed Matter Physics, Vol. 6 by Richard A. L. Jones (2002) ISBN-13: 978-0198505891

4. Audiology: Science to Practice, Second Edition by Steven Kramer (2013) ISBN-13: 978-1597565233

NOTE: The above readings comprise the foundational readings for the course and more up-to-date relevant readings will be provided when they are available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Physics in the Semiconductor Industry	1	Lecture Notes	In-person	
2	Physics in the Semiconductor Industry	1	Lecture Notes	In-person	
3	Physics in the Semiconductor Industry	1	Lecture Notes	In-person	
4	Physics in the Biomedical Industry	1	Lecture Notes	In-person	
5	Physics in the Biomedical Industry	1	Lecture Notes	In-person	
6	Physics in the Biomedical Industry	1		In-person	
7	Physics in the Food Industry	1	Lecture Notes	In-person	
8	Physics in the Food Industry	1	Lecture Notes	In-person	
9	Physics in the Food Industry	1	Lecture Notes	In-person	
10	Physics in the Photonics Industry	1		In-person	
11	Physics in the Photonics Industry	1		In-person	
12	Physics in the Photonics Industry	1		In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
13	Report and Presentation	2-3		In-person	Report and presentation slides to be submitted in week 12 and the presentation takes place in week 13.

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	The lectures will help communicate the applications as stated in the learning outcomes.
Periodical Topic Tests	Periodical topic tests will reinforce what is taught in the topic lectures by testing the students on what they have learnt in the lectures.
Presentation	Students can choose a topic they have interest in and learn deeper about it and then demonstrate the knowledge acquired by writing up a report and giving a presentation.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Others([quiz/test] Periodical Tests)	LO 1	Competence	60	Individual	Analytic	Relational
2	Continuous Assessment (CA): Others([presentations] Continuous Assessment (CA): Report & Presentation)	LO 2-3	Communication & creativity	40	Individual	Analytic	Relational

Description of Assessment Components (if applicable)

Component 1 (60%) comprises of a topic test conducted by each guest lecturer at the end of their topic. There are 4 topics so each topic test has a weightage of 15%. The aim of the topic test is a hard assessment to assess students' understanding of that particular topic.

Component 2 (40%) comprises of a report and presentation where the student will research on the applications of Physics in a certain industry. The aim of this mini-research project is to assess the students' skills in finding out how Physics is applied in different industries.

Formative Feedback

The periodical tests allow students to test their competency in their knowledge and understanding at suitably-spaced intervals during the semester. These questions will feedback to the students about their competency and the students’ answers will feedback to the instructors about their understanding of lectures.

The CA which involves the student reading deeper into certain applications and industries will allow the student to explore his/her interest more deeply and ascertain if his/her interest is indeed in the said industry.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Adaptability	Intermediate
Communication	Intermediate
Creative Thinking	Intermediate
Curiosity	Intermediate
Problem Solving	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)

Students are expected to complete all assigned pre-class and post-class readings, attend all classes punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements for classes they have missed. Students are expected to participate in all class discussions and activities.

Students are required to submit compulsory reports and presentation slides on their specified due dates. Late submissions
will field a deduction of 10% per day without exceptions. Assignments are meant to be a reflection of individual work, and plagiarism is taken very seriously. In the event of detection, plagiarized assignments will be given a mark of zero.

Policy (Absenteeism)

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

Policy (Others, if applicable)

Diversity and inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:

- If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety

disorder or social phobia;

- If you feel like your performance in the class is being impacted by your experiences outside of class;
- If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer or a peer or senior (either in-person or via email) about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

Appendix: Assessment Criteria for Report and Presentation

By mark range

Marks	**Criteria**
> 90%	Demonstrates very deep interest and a wider understanding of physics applications in a certain industry.
75% to 89%	Demonstrates deep interest and understanding of physics applications in a certain industry.
65% to 74%	Demonstrates reasonable interest and understanding of physics applications in a certain industry.
50% to 64%	Demonstrates shallow interest and understanding of physics applications in a certain industry.
< 50%	Shows no interest and understanding of physics applications in a certain industry.