Nanyang Technological University
Division of Physics and Applied Physics

Academic Year	2023/24	**Semester**	1
Course Coordinator	Asst. Prof. Bent Weber and Asst. Prof. Endao Han		
Course Code	PH1105		
Course Title	Optics, Vibrations and Waves		
Pre-requisites	Physics and Maths at A or H2 level, or equivalents		
No of AUs	3 AU		
Contact Hours	PH1105 (2 hr – lecture; 1 hr – tutorial)		
Proposal Date	5 June 2023		

Course Aims

This course aims to equip you with basic concepts and problem solving skills in optics and wave phenomena. You will develop physical intuition and basic analytical skills which are important for studying optical rays and wave propagation. Fundamental concepts are emphasized using the framework of phase and wavefronts. These knowledge and skills lay the foundation for subsequent higher level courses in optics, and are also critical in any other wave-related courses such as quantum mechanics and electrodynamics.

Intended Learning Outcomes (ILO)

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

1. Recognize wave behaviour as fundamental to physical phenomena;
2. Describe the nature of light; identify and apply the fundamental principles of geometric optics; apply geometric optics to explain how camera, telescope, and microscope work;
3. Describe and explain simple harmonic oscillation, damped and driven oscillations; recognize and apply phase and phasor diagrams;
4. Write down and solve wave equations; describe the characteristics of mechanical waves; describe concepts and phenomena such as wave attenuation, phase and group velocity, beats, standing waves, and Doppler effect; apply Huygen's principle and superposition;
5. Describe and explain sound and hearing;
6. Describe basic properties of electromagnetic waves; describe and explain interference and diffraction, including Young's double slits experiment, diffraction grating, limits of resolution, and interference in thin films; describe how Michelson's interferometer, spectrometer, and x-ray diffraction work;
7. Explain matter waves.

Course Content

Geometrical Optics
Basic properties of light; reflection, refraction and dispersion; lensmaker's equation; real and virtual images; cameras, telescope and microscope.

Oscillations
Simple Harmonic Motion; relative phases; pendulums; damped and driven oscillations; phasor diagrams.

Waves and Sound
Wave equation, characteristics of waves; wave attenuation; phase, group velocity; Huygen's principle, superposition and interference; sound waves and characteristics; beats; standing waves; Doppler effect.

Wave Optics
Electromagnetic waves; interference, diffraction; Young's slits and diffraction grating; Limits of resolution; Interference in thin films; Scattering of light; Michelson's interferometer; Spectrometer, X-ray diffraction, Bragg's equation; polarization; Brewster's angle.

Assessment (includes both continuous and summative assessment)

Component	ILO Tested	Weighting	Team/Individual	Assessment Rubrics
1. Final examination (2.5-hour written examination)	All	60%	Individual	Point-based marking (not rubric-based)
2. Continuous Assessment 1 (CA1): Online "MasteringPhysics" (weekly)	All	10%	Individual	Point-based marking (not rubric-based)
3. CA2: Midterm test	1, 2, 3, and 4	20%	Individual	Point-based marking (not rubric-based)
4. CA3: Learning Catalytics (weekly during lecture)	All	10%	Individual	Point-based marking (not rubric-based)
Total		100%		

Weekly Lecture Quizzes (10%)
You are expected to attend lectures and participate in the Learning Catalytics (LC) quizzes during lecture. This will earn valuable points for the CA. These quizzes are interactive in nature and are primarily meant for formative assessment and are usually not too hard. Scores will be given based on participation. There will be 11-12 such LC assessments, one in each lecture (except final lecture). Each quiz counts 1% of the final grade (1/10th) as we count 10 quizzes total. Should you miss a lecture due to illness, you can still achieve the maximum grade. There will be no make up quizzes for students who miss lectures. In the event that a student is on long term medical leave that makes him or her unable to attend lectures, the student should inform the lecturer as soon as possible.

Formative feedback
You will receive formative feedback through discussion within tutorial lessons as well as interactive, computer-based hints and pointers in the Mastering Physics online assignment and resource system.
Formative feedback is also given via the student response application Learning Catalytics where you are required to answer on your mobile devices questions posted during lecture/tutorial. Feedback is always provided for your response to each question.
Finally, feedback is also given after midterm test on the common mistakes and level of difficulty of the problems. Past exam questions and examiner's report are also made available for you.

Learning and Teaching approach

Approach	How does this approach support you in achieving the learning outcomes?
Problem solving (tutorial and lecture)	Develop competence and perseverance in solving physics problems
Learning Catalytics (tutorial and lecture)	Provide immediate feedback to correct misconceptions
In-class demos and videos	Help to establish physics intuition based on experiment

Reading and References

1. University Physics with Modern Physics, 14th Edition, H. D. Young and R. A. Freedman, Pearson (2016) ISBN-13: 9780133975987
2. Physics for Scientists & Engineers with Modern Physics, 4th Edition, D. C. Giancoli, Pearson (2008) ISBN 13: 9780131495081
3. College Physics: A Strategic Approach Edition, 3rd Edition, R. D. Knight, B. Jones, S. Field, Pearson (2015) ISBN-13: 9780321879721

Course Policies and Student Responsibilities

Expectations

- Students are expected to be independent and self-directed.
- As young adults learning at the University level, students are expected to take responsibility for their learning, be well prepared for and participate actively in class.
- The University does not condone cheating or any form of plagiarism.

Policy on Collaboration

Discussion of course material and homework problems is permitted and encouraged. However, each student should work through the homework problems and submit her/his own solutions independently.

According to NTU's Honour Code, the following is NOT allowed:

- Cheating: Bringing or having access to unauthorized books or materials (be it print or electronic) during an exam or assessment, or in any work to be used by the lecturer, tutor, instructor or examiner as a basis of grading.
- Plagiarism: To use or pass off as one's own, the writings or ideas of another, without acknowledging or crediting the source from which the ideas are taken.
- Collusion: Submitting an assignment, project or report completed by another person and passing it off as one's own; Preparing an assignment, project or report for a fellow student who submits the work as his or her own.

Policy regarding Absence

- Students are expected to be present and punctual for all lectures, tutorial classes and examinations. This is in your own best interest given the LC online quiz during lecture time.

- There will be no make up for students who miss LC quizzes. However, special consideration may be given for students who are on long-term medical leave.
- Any absence must be accompanied by a Medical Certificate (MC), which are to be submitted online to the School. A picture of the MC should be taken and emailed to the Lecturers and/or Teaching Assistant of the tutorial class.

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
Asst. Prof. Bent Weber	PAP-05-01b	6904 1249	b.weber@ntu.edu.sg
Asst. Prof. Endao Han	PAP-03-09	6513 8494	endao.han@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
Week 1	Introduction	1	Lecture Notes, In-class Learning Catalytics Mastering Physics on-line assignment, Post-tutorial videos
Week 2	Nature and propagation of light	2	
Week 3	Geometric optics	2	
Week 4	Periodic motion	3	
Week 5	Mechanical waves	4	
Week 6	Mechanical waves	4	
Week 7	Midterm test	1, 2, 3, 4	
Week 8	Sound and hearing	5	Lecture Notes, In-class Learning Catalytics Mastering Physics on-line assignment, Post-tutorial videos
Week 9	Interference	6	
Week 10	Interference	6	
Week 11	Diffraction	6	
Week 12	Diffraction	6, 7	
Week 13	Revision	All	