Academic Year	2020/21	**Semester**	2
Course Coordinator	Assoc Prof S.N. Piramanayagam Assoc Prof Gao Weibo		
Course Code	PH1801		
Course Title	Foundations of Physics I		
Pre-requisites	Nil		
Mutually Exclusive	CY1301, CY1305, PH1011, PH1012, PH1101, PH1104, PH114S		
No of AUs	3		
Contact Hours	39 (26 hours of Lecture, 13 hours of Tutorial)		
Proposal Date	14 December 2020		

Course Aims

This course aims to introduce Physics to the students who have not studied advanced physics in their pre-university education. The course has two parts. The first part provides the fundamentals of Newtonian Mechanics. The second part discusses the basics of thermal physics. The students will develop the curiosity towards Physics in their everyday life. They will develop the analytical skills and solve problems involving mechanical systems and thermal physics.

Intended Learning Outcomes (ILO)

Upon successful completion of this course, the student should be able to:

Mechanics

1. Explain the significance of numerical systems, units and various other physics principles in their real life.
2. Perform addition or subtraction of vectors, solve 1D and 2D kinematics problems (such as motion along a ramp or projectile motion) under uniform acceleration
3. Draw and analyse graphs related to the motion of objects (displacement-time, velocity-time, etc.)
4. Apply Newton's law of motion to analyze the effects of forces acting on an object
5. Apply impulse-momentum relation and to estimate the velocity or mass of objects from this relation and law of conservation of momentum
6. Apply the work-energy relation and estimate the height, velocity or the unknown properties using these relations
7. Analyse and solve circular and rotational motion problems and determine the effect of torque and moment of inertia of objects

Thermal Physics

8. Explain the concept of temperature and heat, and they affect matter
9. Interpret and explain eat transfer, Internal energy andharnessing of thermal energy to do work (thermodynamics)
10. Use macroscopic Description of An Ideal Gas to solve gas problems related with their temperature, volume, pressure.
11. Identify and interpret internal Energy, heat and Mechanical equivalent of Heat; Apply calorimetry and Specific heat, Latent heat (phase change) equation to calculate heat involved.

12. Draw PV diagram and interpret the first law of thermal dynamics correctly including the process of Isovolumetric(molar specific heat at const. V); Isobaric (molar specific heat at const. P); Isothermal and Adiabatic process
13. Apply the second law of thermal dynamics to explain the concept of engine efficiency and entropy.

Course Content

S/N	Topic	Lecture Hours	Tutorial Hours
1	Mechanics • Numerical systems, units, vectors • Motion diagrams, position-time and velocity-time graphs, velocity and acceleration • Motion in 2D, Forces, Newton's laws of motion • Momentum, impulse, momentum-impulse relation, law of conservation of momentum, elastic and inelastic collisions, • Gravitational potential energy, kinetic energy and law of conservation of energy • Circular motion, centrepetal acceleration • Rotational motion, moment of inertia, Torque, law of conservation of angular momentum	14 hours	7
2	Thermal Physics • Temperature, Thermometers, Thermal expansion • Macroscopic and Kinetic theory of gases • Equation of State of Ideal Gas • Internal Energy, heat and Mechanical equivalent of Heat • Calorimetry, heat transfer • First law of thermodynamics • Second law of thermodynamics	12 hours	6

Assessment (includes both continuous and summative assessment)

Component	**Course LOs Tested**	**Graduate Attributes**	**Weighting**	**Team/Individual**	**Assessment rubrics**
1. Final Examination	1-13	A1-A4, B2,	50%	Individual	
2. Continuous Assessment 1 (CA1): Mid-term Test	1-7	A1-A4, B2,	30%	Individual	
3. CA2: Online assignment	1-13	A1-A4,	10%	Individual	
4. CA3: In-class test	1-13	A1-A4	10%	Individual	

Total	100%		

Formative feedback

1. Through the online assignment, the students can regularly monitor and know their progress in learning
2. In class, the use of polls and the correct answers give feedback to the students about how their learning has been.
3. The discussion of mid-term test papers give information on the performance of students.
4. A mock test is offered to the interested students to find out their level of understanding.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Learning events	The lectures are designed to be interactive and involve the learning of students in an interactive manner. This mode of learning helps the students to get rid of their fear on physics and to enjoy learning Physics. Eventually, the develop competence in solving physics problems and relate to the simple physics concepts in real life.
Problem solving (Tutorial, Mastering Physics and TurningPoint)	Through the use of simple problems in lectures, plus more and more complex problems in the MasteringPhysics and Tutorials, the students develop competency in solving Physics problems.

Reading and References

1. College Physics: A strategic Approach, R.D. Knight, B. Jones and S. Field, 3rd Edition, Pearson, 2014 ISBN: 9781292057156

Course Policies and Student Responsibilities

Students are expected to do the online assignments and participate in the TurningPoint polls. If the students are unable to attend mid-term due to medical reasons, they have to produce medical certificate* and request for a replacement/makeup mid-term test.

*The medical certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.

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
S.N. Piramanayagam	SPMS-PAP-05-05	65923148	prem@ntu.edu.sg
Gao Weibo	SPMS-PAP-03-06	63162964	wbgao@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to the course, Numbers, Units and their significance, Vectors	1 & 2	Lectures, LAMS, TurningPoint polls, MasteringPhysics and Tutorials
2	Motion Diagram, 1D motion	2 &3	
3	2D Motion, Forces and Newton's laws of motion	2 & 4	
4	Momentum, Impulse, Law of conservation of momentum, Work, Energy	5 & 6	
5	Circular motion and rotational motion	7	
6	Revision of topics and mock-test	1-7	
7	Mid-Term test		Quiz 1
8	Temperature, Thermometers, Thermal expansion	8&9	Lectures, LAMS, TurningPoint polls, MasteringPhysics and Tutorials
9	Macroscopic and Kinetic theory of gases	10	
10	Calorimetry: Energy transfer	11	
11	First law of thermodynamics	12	
12	Second law of thermodynamics	13	
13	Final review	8-13	

Graduate Attributes

What we want our graduates from Physics and Applied Physics to be able to do:

Upon the successful completion of the PHY, APHY and PHMA programs, graduates should be able to:

Competency	A1	demonstrate a rigorous understanding of the core theories and principles of physics involving (but not limited to) areas such as classical mechanics, electromagnetism, thermal physics and quantum mechanics;
		[PHMA only] demonstrate a rigorous understanding of the core theories and principles of mathematical sciences involving (but not limited to) areas such as analysis, algebra and statistical analysis;
	A2	read and understand undergraduate level physics content independently;
	A3	make educated guesses / estimations of physical quantities in general;
	A4	apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, model and solve problems;
	A5	develop theoretical descriptions of physical phenomena with an understanding of the underlying assumptions and limitations;
	A6	critically evaluate and distinguish sources of scientific/non-scientific information and to recommend appropriate decisions and choices when needed;
	A7	demonstrate the ability to design and conduct experiments in a Physics laboratory, to make measurements, analyse and interpret data to draw valid conclusions.

Creativity	B1	propose valid approaches to tackle open-ended problems in unexplored domains;
	B2	offer valid alternative perspectives/approaches to a given situation or problem.

Communication	C1	describe physical phenomena with scientifically sound principles;
	C2	communicate (in writing and speaking) scientific and non-scientific ideas effectively to professional scientists and to the general public;
	C3	communicate effectively with team members when working in a group.

Character	D1	uphold absolute integrity when conducting scientific experiments, reporting and using the scientific results;
	D2	readily pick up new skills, particularly technology related ones, to tackle new problems;
	D3	contribute as a valued team member when working in a group.

Civic Mindedness	E1	put together the skills and knowledge into their work in an effective, responsible and ethical manner for the benefits of society.