Nanyang Technological University
Division of Physics and Applied Physics

Academic Year	2020/21	**Semester**	1
Course Coordinator	Assoc. Prof. Elbert Chia Asst. Prof Justin Song		
Course Code	PH1104 / PH114S[1]		
Course Title	Mechanics		
Pre-requisites	Physics and Mathematics at A or H2 level, or equivalents		
No of AUs	3 AU		
Contact Hours	PH1104 (2 hr – lecture; 1 hr – tutorial)		
Proposal Date	3 March 2020		

Course Aims

This course aims to equip you with the basic concepts and problem solving skills in Mechanics. You will develop physical intuition and analytical skills which are important for studying physical systems and solve problems involving mechanical systems. These knowledge and skills lay the foundation for subsequent higher level courses.

Intended Learning Outcomes (ILO)

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

Linear Motion & Dynamics (LIN) :

1. perform basic vector operations (such as scalar and vector products, component addition and decomposition) and solve problems involving vector quantities.
2. analyse and solve 1D and 2D kinematics problems (such as projectile motion).
3. analyse problems involving non-constant accelerations using basic calculus.
4. analyse graphs relating to the motion of objects (such as displacement-time, velocity-time and acceleration-time graphs).
5. apply Newton's laws of motion to analyse the effects of forces acting on a system of objects in 1D and 2D.
6. analyse the effects of air resistance and frictional forces on the motion of objects.
7. apply the work-energy relation and conservation of energy to evaluate problems involving linear mechanics.
8. derive the impulse-momentum relation, conservation of linear momentum and use them to analyse and solve collision, explosion, mass flow related problems.

Rotational/Circular Motion & Dynamics (ROT) :

9. analyse and solve circular motion problems for point objects and rotational motion problems for rigid bodies.
10. determine the centre of mass, moment of inertia of objects of simple geometry and solve problems related to static equilibrium and rotational motion.
11. apply Newton's laws of motion to analyse the effects of torque acting on a system of objects in rotational motion.
12. analyse and solve oblique collision problems using conservation of angular momentum.
13. analyse and solve advanced problems relating translational motion and rotational motion in rolling.
14. apply Newton's law of gravitation and rotational kinematics to analyse and solve problems.

Course Content

Linear Motion & Dynamics (LIN) :
Vectors
Vector Decomposition
Vector Addition

[1] PH114S is a self-paced version of the course

Scalar Product (Dot Product)
Vector Product (Cross Product)

1D and 2D Kinematics
Newton's Laws of Motion
Work, Energy and Power
Conservation of Energy
Linear Kinetic Energy
Impulse and Momentum
Conservation of Linear Momentum

Rotational/Circular Motion & Dynamics (ROT) :
Circular Motion
Rotational Kinematics
Moment of Inertia
Rotational Dynamics
Center of Mass
Rotational Kinetic Energy
Conservation of Angular Momentum
Rolling with Slipping
Rolling without Slipping

Gravitational Force
Gravitational Potential Energy

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team / Individual	Assessment Rubrics
1. Final Examination	All	Competence (1, 2, 3, 4, 5, 6) Creativity (1, 2) Communication (1, 2)	60%	Individual	Point-based marking (not rubric-based) and Open-ended marking scheme*
2. CA1: Mastering Physics online assignments	All	Competence (1, 2, 3, 4, 5, 6) Creativity (1, 2) Communication (1, 2)	20%	Individual	Point-based marking (not rubric-based) Using Mastering Physics
3. CA2: Quiz 1	LIN 1-4	Competence (1, 2, 3, 4, 5, 6) Communication (1, 2)	5%	Individual	Point-based marking (not rubric-based)
4. CA3: Quiz 2	LIN 2-7	Competence (1, 2, 3, 4, 5, 6) Creativity (1, 2) Communication (1, 2)	5%	Individual	Point-based marking (not rubric-based) and Open-ended marking scheme*
5. CA4: Quiz 3	LIN 8, ROT 9-11	Competence (1, 2, 3, 4, 5, 6) Communication (1, 2)	5%	Individual	Point-based marking (not rubric-based)
6. CA5: Quiz 4	ROT 9-13	Competence (1, 2, 3, 4, 5, 6) Creativity (1, 2) Communication (1, 2)	5%	Individual	Point-based marking (not rubric-based) and Open-ended marking scheme*
Total			100%		

*You would be expected to synthesise the physics concepts learnt in the course to propose scientifically valid approaches to given situations or problems.

Formative feedback

You will receive formative feedback is given 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 Clickers (ResponseWare) 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 each Quiz on the common mistakes and level of difficulty of the problems. Past Quiz questions are also made available for you.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Problem solving (MasteringPhysics)	Develop competence and perseverance in solving physics problems with immediate learning feedback
Problem solving (tutorial and lecture)	Develop competence and perseverance in solving physics problems
Peer Instruction (during lecture)	Develop communication skills and competence in physics. You are encouraged to discuss their answers to the Clickers questions so that they can learn from one another.

Reading and References

1. University Physics with Modern Physics, 14th Edition, Hugh Young and Roger Freedman, Pearson (2015). ISBN 13: 9780321973610
2. Physics for Scientists and Engineers, 8th Edition, R A Serway and J W Jewett Jr, Brooks Cole (2009). ISBN 13: 9780495112457

Course Policies and Student Responsibilities

Absence Due to Medical or Other Reasons

If you are sick and unable to attend your class / Mid-terms, you have to:

1. Send an email to the instructor regarding the absence and request for a replacement class and make-up mid-terms.
2. Submit the original Medical Certificate* or official letter of excuse to administrator.
3. Attend the assigned replacement class (*subject to availability*) and make-up mid-terms.

* 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
Assoc. Prof. Elbert Chia	SPMS-PAP-04-13	6513-8132	elbertchia@ntu.edu.sg
Asst. Prof. Justin Song	SPMS-PAP-04-07	6513-7411	justinsong@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to course; Vectors	LIN 1	Lectures, Tutorials, Clickers (ResponseWare), Mastering Physics online assignment
2	1D Kinematics	LIN 2	
3	2D Kinematics	LIN 2	
4	Forces and Newton's laws of Motion	LIN 3-4	
5	Forces and Newton's laws of Motion	LIN 5-6	Quiz 1
6	Work, Energy and Power	LIN 7	Lectures, Tutorials, Clickers (ResponseWare), Mastering Physics online assignment
7	Conservation of Energy	LIN 8	Quiz 2
8	Impulse-Momentum; Conservation of Momentum	LIN 8	Lectures, Tutorials, Clickers (ResponseWare), Mastering Physics online assignment
9	Impulse-Momentum; Conservation of Momentum	LIN 8	Quiz 3
10	Rotational Kinematics; Moment of Inertia	ROT 9	Lectures, Tutorials, Clickers (ResponseWare), Mastering Physics online assignment
11	Rotational Dynamics	ROT 10-11	
12	Rotational Dynamics	ROT 12-13	Quiz 4

13	Gravitation	ROT 14	Lectures, Tutorials, Clickers (ResponseWare), Mastering Physics online assignment

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	1	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
	2	read and understand undergraduate level physics content independently;
	3	make educated guesses / estimations of physical quantities in general;
	4	apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, model and solve problems;
	5	develop theoretical descriptions of physical phenomena with an understanding of the underlying assumptions and limitations;
	6	critically evaluate and distinguish sources of scientific/non-scientific information and to recommend appropriate decisions and choices when needed;
	7	demonstrate the ability to design and conduct experiments in a Physics laboratory, to make measurements, analyse and interpret data to draw valid conclusions.

Creativity	1	propose valid approaches to tackle open-ended problems in unexplored domains;
	2	offer valid alternative perspectives/approaches to a given situation or problem.

Communication	1	describe physical phenomena with scientifically sound principles;
	2	communicate (in writing and speaking) scientific and non-scientific ideas effectively to professional scientists and to the general public;
	3	communicate effectively with team members when working in a group.

Character	1	uphold absolute integrity when conducting scientific experiments, reporting and using the scientific results;
	2	readily pick up new skills, particularly technology related ones, to tackle new problems;
	3	contribute as a valued team member when working in a group.

Civic Mindedness	1	put together the skills and knowledge into their work in an effective, responsible and ethical manner for the benefits of society.