NANYANG TECHNOLOGICAL UNIVERSITY

Teaching, Learning and Pedagogy Division

Reg. No. 200604393R

COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2018/19	**Semester**	1 & 2
Course Coordinator	Assistant Professor Zhou Yufeng & Associate Professor Yap Fook Fah		
Course Code	MA1001		
Course Title	Dynamics		
Pre-requisites	Having read (PH1011/FE1011/CY1308 Physics or PH1012/FE1012 Physics A or CY1301 Mechanics) **and** (MH1810/FE1006 Mathematics I or MA1003 Essential Mathematics or CY1201 Calculus of One Variable)		
No of AUs	3		
Contact Hours	Lectures: 26 hours Tutorials: 12 hours		
Proposal Date	24 April 2018		

Course Aims

The aim of this course is to introduce the fundamental concepts and principles of dynamics to undergraduate mechanical & aerospace engineering students. This course is designed for you to understand the characteristic planar motion of particles and rigid bodies. Throughout the course the vector is used as a basic mathematical tool to derive all equations. Intensive training in vector analysis will be of great help for you to understand in depth the concepts and principles in Dynamics. The course will cover both kinematics and kinetics of particle and rigid bodies. It focuses on the key problems in the mechanics, such as the definition of a reference frame, concepts of translation and rotation of rigid body, circular motion of a particle, and principles in kinetics for motion of particle and rigid body.

After the study, you will be equipped with the basic knowledge for further study in the broad field of engineering.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, you will be able to:

LO1) Use vector operators to derive the equations in the field of engineering.

LO2) Analyze the kinematics of a particle in order to predict its motion in standard 1-D and 2-D coordinate systems.

LO3) Analyze the forces acting on a particle or predict the motion of a particle resulting from external forces in a mechanical system.

LO4) Analyze the kinematics of a rigid body or a connected system of rigid bodies in order to predict the motion of the body(s) and /or the motion of a point on the body(s).

LO5) Analyze the forces acting on a rigid body or predict the motion of a rigid body resulting from external forces in a mechanical system.

Course Content

	Topic	Hours
1.	**Kinematics of Particles** Vectors and vector operation. Reference frame and Cartesian coordinate systems. Position, velocity and acceleration. Simple planar motions: Rectilinear and circular motion. Plane curvilinear motion of particles. Motion relative to a point-attached translating frame. Constrained motion of connected particles. Example applications.	**7**
2.	**Kinematics of Rigid Bodies** Particle and rigid body Simple plane motion of rigid slab: translation and rotation about fixed point. General plane motion. Instantaneous center of velocity. Motion of point relative to body-attached moving reference. Principle of velocity combination: relative and entrained velocities. Principle of acceleration combination: relative, entrained and Coriolis accelerations. Example applications.	**6**
3.	**Kinetics of Particles** Newton's second law and inertial reference. Principle of angular momentum. Principle of work and kinetic energy. Principle of linear/angular impulse and momentum. Conservative forces and conservation of total energy. Conservation of linear/angular momentum Direct and oblique collision and collision with constraints. Example applications.	**7**
4.	**Kinetics of Rigid Bodies** Principle of linear momentum of mass center. Principle of angular momentum about mass center. Moment of inertia. Principle of angular momentum about a fixed point. General plane motion. Principle of work and kinetic energy. Principle of linear/angular impulse and momentum. Conservation of total energy. Example applications.	**6**

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
1. Continuous	LO1,	*EAB SLO a, b, c*	10%	Individual	

Assessment 1 – Quiz 1	LO2				
2. Continuous Assessment 2 – Quiz 2	LO1, LO3	*EAB SLO a, b, c*	10%	Individual	
3. Continuous Assessment 3 – Quiz 3	LO1, LO4	*EAB SLO a, b, c*	10%	Individual	
4. Continuous Assessment 4 - Participation & LAMS completion	LO1-LO5	*EAB SLO a, b, c*	10%	Individual	
5. Final Examination – Restricted Open Book; 2.5hrs	LO1-LO5	*EAB SLO a, b, c*	60%	Individual	
Total			100%		

Formative feedback

As the lecturer and tutor, several strategies will be employed to provide constructive and timely feedback on your study.

In each LAMS sequence, there are several checking point questions and a short lecture quiz to test the degree of understanding. Explanation of answers will be provided immediately. Summary of each lecture will be available at the end of each LAMS sequence while the brief review of previous lecture will be at the beginning. Answers to common questions on the teaching materials from previous students could be found in the course blog and will be updated continuously.

Further questions could be answered by email or face-to-face consultation in the office.

Explanation of Past Year Papers is available to avoid the popular pitfalls.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Blended learning with active use of multi-media resources	This will permit flexibility of access to learning materials, activities and assessments and can help you develop independent learning and critical thinking skills
Software simulations	This will allow you to develop realistic solution to complex problems and will facilitate creative problem solving. Relationship between different kinematic and kinetic parameters could be figured out easily. Motion of particles and rigid bodies could be observed to

	further understand the underlying principles.
Practical examples	This will demonstrate how to apply the principles into the practice and explain the dynamic phenomenon in the engineering field.

Reading and References

Textbook

1. Chen, G. and Yap, F. F., An Introduction to Planar Dynamics, fourth edition, Cengage Learning Asia, 2014.

References

1. R. C. Hibbeler., Engineering Mechanics - Dynamics, SI edition, Prentice Hall Singapore; 13 edition, 2012.

Course Policies and Student Responsibilities

You are expected to complete all LAMS sequences according to the schedule on time, finish check questions and lecture quizzes, and discuss the thinking questions with your classmates. You are expected to take responsibility to follow up with course notes, tutorial assignments and course related announcements. You are expected to participate in all reviewing classes.

Please remember to attend each tutorial session and sign in the attendance sheet if required by the tutor. All non-attendance must be supported by a medical certificate or other officially accepted excuse. If you are absent from class, you must submit valid supporting documents within three working days. If you miss a lecture/tutorial session, you must inform lecturer or tutor via email prior to the start of the class.

Makeup of CA quiz is only available within a week for those who is absent with valid reasons, such as falling sick supported by a medical certificate and participation in NTU's approved activities 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 Zhou Yufeng	N3.2-01-25	6790 4482	yfzhou@ntu.edu.sg
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Dr Wu Mao See	N3.2-01-16	6790 5545	MMSWU@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Reference system, position, velocity and acceleration	LO1 and LO2	LAMS
2	Plane and circular motion of a particle	LO2	LAMS and tutorial
3	Planar curvilinear motion of particles	LO2	LAMS and tutorial
4	Relative and constrained motion of particle	LO2	LAMS and tutorial
5	General planar motion of rigid body	LO3	LAMS and tutorial
6	Motion relative to a body attached reference	LO3	LAMS and tutorial
7	Newton's laws and inertial reference	LO4	LAMS and tutorial
8	Principle of work and kinetic energy, linear/angular impulse and momentum	LO4	LAMS and tutorial
9	Conservative force, potential energy, conservation of linear/angular momentum	LO4	LAMS and tutorial
10	Collision and impact force, Newton's 2nd law for rigid bodies	LO4 and LO5	LAMS and tutorial
11	Principle of angular momentum, general planar motion of a rigid slab	LO5	LAMS and tutorial
12	Principle of work and kinetic energy and conversation of total energy for a rigid slab	LO5	LAMS and tutorial
13	Principle of impulse and momentum for a rigid slab	LO5	LAMS and tutorial