Mech Eng 2QA4
Engineering Mechanics: Kinetics and Dynamics

Undergraduate Studies
Fall 2020
Course Outline

CALENDAR/COURSE DESCRIPTION

Kinematics and dynamics of particles and rigid bodies. Analysis of planar mechanisms. Displacement, velocity and acceleration analysis methods. Motion with respect to a rotating frame reference. Work, energy and momentum principles.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in Level II of any Mechatronics Engineering program.
Antirequisite(s): CIVENG 2Q03, 2Q04, ENGINEER 2Q04, MECHENG 2Q04, 2QR4

INSTRUCTOR CONTACT INFORMATION

Dr. Gary Bone
gary@mcmaster.ca **(Please include "Mech Eng 2QA4" in the subject line of your email message)**

TEACHING ASSISTANT CONTACT INFORMATION

Behrad Rouzbeh
rouzbehb@mcmaster.ca

COURSE WEBSITE

http://avenue.mcmaster.ca/ (Please note: Microsoft Teams will be used for the lectures and tutorials)

MATERIALS AND FEES

Required Textbook:
R.C. Hibbeler, **Engineering Mechanics: Dynamics**, 14th Edition (older editions that cover the same material are also fine), Prentice Hall, 2017. To purchase the hardcover textbook or the electronic version (E-TEXT) at the Campus Store use the link: https://campusstore.mcmaster.ca/cgi-mcm/ws/txsub.pl?wsTERMG1=204&wsDEPTG1=MECHENG&wsCOURSEG1=2QA4&wsSECTIONG1=DAY%20C01&crit_cnt=1

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- Three live lectures per week on Microsoft Teams (Mon: 5:30-6:20, Tue: 4:30-5:20 and Thur: 5:30-6:20).
- Worked examples will be presented in every lecture.
- One live tutorial (2 hours) per week on Microsoft Teams. Tutorials will start on Sept. 18th.
- **Pop quizzes held during the lectures.**
- Three midterm tests (50 minutes each, held in 3 of the lecture timeslots if possible).
- One final exam (2.5 hours).

COURSE INTENDED LEARNING OUTCOMES

By the end of this course, students should be able to:

- Draw free-body diagrams and kinetic diagrams.
- Apply physics, calculus, algebra, and trigonometry to solve kinematics and kinetics problems.
- Solve particle kinematics problems.
- Solve particle kinetics problems and planar kinetics problems involving translation and rotation of multiple rigid bodies.
- Solve kinetics problems using approaches based on Newton's second law of motion; work and energy; and impulse and momentum.
- Analyze power and efficiency.
- Calculate the mass moment of inertia of composite bodies.
- Solve one-degree-of-freedom vibration problems.

COURSE SCHEDULE

Lectures	Topic	Readings from Hibbeler (14th ed.)
1 - 6	Kinematics of a Particle	12.1-12.7, 12.9 and 12.10
7-9	Kinetics of a Particle: Force and Acceleration	13.1-13.5
10-11	Kinetics of a Particle: Work and Energy	14.1-14.6
12-14	Kinetics of a Particle: Impulse and Momentum	15.1-15.4
15-17	Planar Kinematics of a Rigid Body	16.1-16.3, 16.5, 16.7 and 16.8
18-20	Planar Kinetics of a Rigid Body: Force and Acceleration	17.1-17.5
21-22	Planar Kinetics of a Rigid Body: Work and Energy	18.1-18.5
23-25	Planar Kinetics of a Rigid Body: Impulse and Momentum	19.1-19.4
26-29	Vibrations	22.1, 22.3, 22.4 and 22.5
30-34	Brief Introduction to Robot Kinematics and Dynamics	Notes by Dr. Bone

ASSESSMENT

Component	Weight
In-class Pop Quizzes	5%
Test 1	10%
Test 2	15%
Test 3	15%
Final Exam	55%
Total	100%

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**

- Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.
- **Students may submit requests for relief using the MSAF once per term.**
- An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
- The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
- The MSAF cannot be used for academic work that has already been completed attempted.
- An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
- The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**

   - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
   - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**
Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/
The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn or Microsoft Teams for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms. This course will use on-line elements (e.g. e-mail, Microsoft Teams, Avenue to Learn (A2L), etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Mechanical Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office.

PHYSICAL AND MENTAL HEALTH

For a list of McMaster University's resources, please refer to the Student Wellness Centre.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. **The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors**
The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by the instructor for the purpose of authorized distribution. Students should be aware that their voice and/or image may be recorded during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

The instructor and university reserve the right to modify elements of a course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course website weekly during the term and to note any changes.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
1. Knowledge Base for Engineering	1.4.Competence in Specialized Engineering Knowledge
2. Problem Analysis	2.1 Demonstrates an ability to identify reasonable assumptions that could/should be made before a solution path is defined. 2.2 Demonstrate an ability to identify a range of suitable engineering fundamentals that are potentially useful for analyzing a technical problem.

For more information on Accreditation, please visit: https://www.engineerscanada.ca