

Course: MENG 253 – Dynamics & Mechanics of Machines, 2020
Instructor: **In Class:** Benj Birch, B. Eng., M.A.Sc.
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Calendar Description

Students will learn about the components of velocity and acceleration, motion analysis, force/acceleration, work/energy, and impulse/momentum principles applied to particles, systems of particles, and rigid bodies. Students will also study the kinematics and dynamics of mechanisms to determine the velocity, acceleration, and forces acting on each component. Analyzed mechanisms include four-bar-links, piston-sliders, cams and gear trains. Systems will be analyzed using analytical, graphical and/or computer-aided methods, with an emphasis on practical applications and case studies.

Intended Learning Outcomes

Upon successful completion of this course a student will be able to:

- Explain the kinematics of particles and groups of particles (how particles move and accelerate relative to a stationary axis and how they move relative to other particles).
- Explain the kinetics of particles and groups of particles using: force/acceleration, impulse/momentum, and work/energy methods (how particles are influenced by external forces).
- Analyze mechanisms, graphically and analytically, to determine velocity, acceleration and force.
- Calculate the angular velocities of gears in simple, compound, and epicyclic gear trains (single and dual input).
- Select the mass and radius of flywheels to minimize the needed power output of the prime-mover in applications with varying power requirements or to smooth the varying output of a power source.

References

Engineering Mechanics: Dynamics or Engineering Mechanics: Statics and Dynamics,
R.C. Hibbeler. Any edition but more recent preferred.

Course Outline (subject to modification, if necessary)

Week	Lab	Due	Course Content
1	-	-	<i>Kinematics of particles:</i> Position, velocity and acceleration.
2	Lab 1A	Assign #1	Curvilinear coordinate systems, $n-t$ coordinates, cylindrical (polar) coordinates, curvilinear motion of particles.
3	Lab 1B	Assign #2	<i>Kinetics of particles:</i> Newton's 2 nd Law, forces and accelerations. Newton's Laws applied to systems of particles.
4	Lab 2A	Assign #3	<i>Kinetics of particles:</i> Work/Energy principles applied to a single particle, and a system of particles.
5	Lab 2B	Assign #4	<i>Kinetics of particles:</i> Linear impulse and momentum applied to a single particle, and a system of particles.
6	Review	Assign #5	Review
7	Term 1 Test	-	Introduction to mechanisms, complex numbers, degrees of freedom, review of vectors, position analysis, velocity analysis.
8	Lab 3A	Assign #6	Relative velocities in mechanisms, relative sliding velocity.
9	Lab 3B	Assign #7	Linear and angular acceleration analysis in mechanisms, relative acceleration examples.
10	Lab 4A	Assign #8	Coriolis and sliding acceleration analysis.
11	Lab 4B	Assign #9	Static forces in machines, inertial forces in machines.
12	Lab 5A	Assign #10	Combined static and inertial force examples.
13	Lab 5B	Assign #11	Gears and gear trains, planetary gear trains.
14	Review	Assign #12	Analysis of cams and cam design, flywheels.

Labs & Assignments

Lab sessions will consist of tutorials and in-class exercises, potentially using AutoCAD, MS Excel, and/or MATLAB software, if required. **No late lab exercises or assignments will be accepted for grading. Note that assignments are due every Friday at 5:30 of the week given in the above table**, and are to be submitted to D2L as a single PDF for each assignment and marks will be awarded for completion. See <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for the Camosun grading policies.

Evaluation & Grading System

Assignments	15%		
Labs	15%		
Term Exam 1	35%	(closed book/notes)	→ You must pass both term exams in order to pass MENG 253
Term Exam 2	35%	(closed book/notes)	

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Immediate, Urgent, or Emergency Support



If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), SEEK HELP. Resource contacts can be found at <http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>.

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