Course: MENG 253– Mechanics and Vibrations of Machines, 2018
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Calendar Description

Students will 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. The course presents an introduction to the vibration analysis of linear systems, including first-order systems incorporating step and impulse inputs. Free and forced excitation of single- and two-degree-of-freedom systems will be analysed using analytical, graphical and/or computer-aided methods, with an emphasis on practical applications and case studies.

Only open to students in the Mechanical Engineering Technology program.

Intended Learning Outcomes

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

- Analyze mechanisms, graphically and analytically, to determine velocity, acceleration and force.
- Calculate the angular velocities of gears in simple, compound, and planetary gear trains.
- 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.
- Analyze one and two-degree of freedom, free and forced, damped and undamped, vibrating systems to determine natural frequencies and amplitude ratios:
    - using Coulomb, hysteresis, and viscous damping models
    - for steady-state and transient responses.
- Select vibration isolation and transmission devices to produce the desired transmission ratios.
- Calculate the balance of systems of reciprocating and rotating masses.

Text & References

No course textbook is required for MENG 253.

Course Outline (subject to modification, if necessary)

Week	Lab (Sections)	Due	Course Content
1	-	-	Introduction to mechanisms, complex numbers, degrees of freedom, review of vectors, position analysis, velocity analysis.
2	Lab 1	Assign. #1	Relative velocities in mechanisms, relative sliding velocity, instantaneous centers of zero velocity.
3		-	Linear and angular acceleration analysis in mechanisms, relative acceleration examples.
4	Lab 2	Assign. #2	Coriolis and sliding acceleration analysis.
5		-	Static forces in machines, inertial forces in machines.
6	Lab 3	Assign. #3	Combined static and inertial force examples.
7		-	Gears and gear trains, planetary gear trains, analysis of cams and cam design.
8	-	Assign. #4	**MIDTERM exam.**
9	Lab 4	-	Introduction to vibration, harmonic functions, free vibration, SDOF undamped systems, spring-mass system modelling.
10		-	Spring-mass system models & methods for determining equations of motion, damped vibration, viscous damping.
11		Assign. #5	Logarithmic decrement, Coulomb damping, resonance, steady-state amplitude.
12	Lab 5	-	Forced, damped vibrations, transient & steady-state response, the effect of damping on amplitude, impulse & non-harmonic forcing, rotational imbalance.
13		-	Balancing rotating masses, 2DOF systems, natural vibration modes, mode shapes.
14		Assign. #6	Vibration suppression and isolation, vibration monographs, dynamic absorbers.

Assignments

Lab sessions will consist of simple experiments, tutorials and in-class exercises using AutoCAD, MS Excel, and MATLAB software, where required. **No late lab reports, exercises or assignments are accepted for grading.**

Evaluation & Grading System

Assignments 20%
Lab Exercises 10%
Midterm Exam 30% (closed book/notes)
Final Exam 40% (closed book/notes)
→ ***You must pass the final exam in order to pass MENG 253***

A+	90-100	B-	70-72
A	85-89	C+	65-69
A-	80-84	C	60-64
B+	77-80	D	50-59
B	73-76	F	<50