

MECH 463 -- Mechanical Vibrations

Dr. G. S. Schajer. Term 1. 2018/19. 4 credits.

This course is designed to develop knowledge and understanding of the vibration of mechanical systems, and to give some experience in making practical vibration measurements. The basic principles learned in previous courses are applied and extended to describe the vibration of multiple degree-of-freedom and continuous systems. This course emphasizes understanding and application of fundamental concepts.

Suggested text: "Mechanical Vibrations: Modeling and Measurement", T.L. Schmitz and K.S. Smith, Springer, 2012.

You can freely download an electronic copy of this textbook from the UBC library. Connect to Springerlink <https://link.springer-com.ezproxy.library.ubc.ca/> when using a campus IP address, search for "Mechanical Vibrations" and download.

Strong recommendation: For US\$24.99 go ahead and buy a printed softcover book using the "MyCopy" button on the right side of the Springerlink page. A printed book is much easier to read and study from than an electronic file, leading to better understanding and enhanced grades.

The class discussion loosely follows the presentations in the textbook. There is no monopoly of wisdom and many other books can give useful additional insights and alternative points of view. Springerlink contains many materials about vibrations, also numerous other subjects. The UBC library catalogue lists 100+ titles under the keyword "Vibrations."

The coursework includes the following components:

1. Lectures: Tu-Th, 8:00-9:20 am, Swing 221.
2. Tutorials: A = Mondays MCML 160 4-5pm, B = Wednesdays CEME 1204 noon-1pm, C = Tuesdays MCLD 254 5-6pm.
3. Two lab experiments done in groups of three students. Lab schedule TBA in class.
4. Approximately ten homework assignments. Solutions will be distributed after one week. Although not formally marked, these assignments are an essential part of the course. Practice gives understanding – best to discover conceptual gaps at home, not in the exam room.
5. Two mid-term exams and a final exam. You may bring one 8"x11" sheet (one side only) of your personal handwritten notes to each exam.

	TAs	
Grading Scheme:	Baharan Pourahmadi	bhrnprhmd@gmail.com
20% Lab experiments	Maryam Mohtajeb	m.mohtajeb@gmail.com
20% Mid-term 1	Ali Moallemi	ali.moallemi91@gmail.com
20% Mid-term 2	Mohammad Keleshteri	mo.mohammadzade@gmail.com
<u>40% Final Exam</u>	Ritukesh Bharali	ritukesh.bharali@gmail.com
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COURSE OUTLINE

The course materials will be chosen from among the following topics :

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1.	1-DOF Review: Review of the vibration of 1 degree-of-freedom systems. Free body diagrams. Trigonometric and complex solutions. Damping. Forced response. Magnification factor.	2.1 2.3, 2.4 3.1-3.3
2.	Vibration Testing: Displacement and acceleration measurements. Spectrum analyzers. Machinery condition monitoring.	2.6, 7.3 1.4, 1.5
3.	2-DOF Systems: Characteristic equation. Mode shapes. Matrix formulations and solutions. Eigenvalue formulations.	4.1,4.2
4.	Mathematical Properties: Semi-definite and unstable systems. Coordinate coupling. Principal coordinates. Proportional damping. Lagrange equations. Orthogonality of mode shapes. Rayleigh Quotient.	4.3,4.4
5.	Forced Vibration: Forced response. Undamped and damped vibration absorbers.	5.1, 5.2 5.3, 5.4
6.	Balancing of Rotating Machinery: One and two plane balancing.	-
7.	Continuous Systems: Wave equation. Separable solutions. String, rod and beam examples. Approximate solution methods.	8.1, 8.2 8.3

EXPERIMENTS:

1. 1-DOF Vibration Measurement of a Damped Engine Mounting. Illustrates use of accelerometers and associated instrumentation to make typical vibration measurements.
2. Multi-DOF Vibration Measurement of a Damped Engine Mounting. Illustrates use of a spectrum analyzer to identify natural frequencies and mode shapes of a multi-DOF system.