Dynamics of Structures

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This course is directed towards first-year graduate students in Structural Engineering, who have been introduced to rigid-body dynamics (usually in their sophomore year, e.g., ME 230 at UW) but have had little exposure to the dynamics of deformable bodies.

This course primarily considers the dynamic response of lumped-mass, single-degree-of-freedom (SDOF) systems and multiple-degree-of-freedom (MDOF) systems. The course will also consider systems with distributed masses and frequency-domain response analysis. The objectives of the course are:

- to provide students with a fundamental understanding of the theory of structural dynamics, as well as typical analytical and numerical methods.
- to provide students with examples of the application of dynamic analysis to practical applications
- to prepare students for Earthquake Engineering I (CEE 515), Wind Engineering Design (CEE 517) and Geotechnical Earthquake Engineering (CEE 526).

Course Outline		Reading (Chopra)
I.	**Introduction**	Ch. 1
	- Role of Dynamic Analysis in Structural Engineering	
	- Dynamics of Particles	
	- Dynamics of Systems of Particles	
	- Dynamics of Rigid Bodies	
II.	**Single-Degree-of-Freedom Systems**	
	- Equation of Motion	Ch. 1
	- Free Vibration	Ch. 2
	- Response to Periodic Excitations	Sec. 3.1-3.7, 3.12
	- Response to Transient Excitations	Ch. 4
	- Numerical Procedures	Ch. 5
	- Earthquake Response	Sec. 6.1-6.7
III.	**Multi-Degree-of-Freedom Systems**	
	- Two-Degree-of-Freedom System	Sec. 9.1-9.2
	- Generalized Coordinates	
	- Free Vibration	Ch. 10
	- Modal Analysis	Ch. 11 & 12
IV.	**Systems with Distributed Mass**	
	- Vibration of Slender Beams	Ch 16
	- Axial Wave Propagation	
V.	**Frequency-Domain Response Analysis** (as time permits)	

Required Text

Chopra A.K., *Dynamics of Structures*, 3rd edition, Prentice Hall, 2007.

Other Texts

- Clough, R. and Penzien, J. (1975), *Dynamics of Structures*, McGraw-Hill Book Co.

- Humar. J.L. (2002), *Dynamics of Structures*, Taylor & Francis.

- Chopra, A. (2005), *Earthquake Dynamics of Structures, A Primer*, Earthquake Engineering Research Institute.

- Torby, J.B. (1984), *Advanced Dynamics for Engineers*, Hold, Rinehart and Winston.

Grading

Homework and in-class assignments	30%
Midterm	30%
Final Exam	40%

10% deduction per weekday for late homework.

Important Dates

Martin Luther King Day	Monday, January 21
President's Day	Monday, February 18
Last Day of Instruction	Friday, March 14
Final Exam	Monday, March 17, 8:30-10:20 AM.

Systems of Units

The problems in the class will use both the English system and SI systems of units. A conversion table is provided for your convenience.

Quantity	English System	SI System	Conversion Factor
Length	foot (ft.)	meter (m)	0.3048
	inch (in.)	meter (m)	0.0254
Force	pound (lb.)	newton (N)	4.4482
	kip (1000 lb.)	newton (N)	4448.2
Mass	slug (lb-sec^2/ft)	kilogram (kg)	14.59
	pound-mass (lbm)*	kilogram (kg)	0.045359
Mass Density	lbm/ft^3	kg/m^3	16.02
	lbm/in^3	kg/m^3	27680.0
Stress/Pressure	lb/ft^2	N/m^2 (Pa)	47.88
	lb/in^2	N/m^2 (Pa)	6894.8
Acceleration	ft/sec^2	m/sec^2	0.3048
	in/sec^2	m/sec^2	0.0254
Velocity	ft/sec	m/sec	0.3048
	in/sec	m/sec	0.0254
Volume	ft^3	m^3	0.028317
Moment/Torque	in-lb	N-m	0.113
	ft-lb	N-m	1.356
Gravity	386.4 in/sec^2	9.81 m/sec^2	0.0254