

## Math 115 - Mathematical modeling

### Scope

The class will describe the fundamental mathematical modeling concepts of dimensional analysis, linearization and normalization, governing equations and mathematical models for various phenomena. The mathematical foundation of calculus of variations will be presented and utilized throughout.

Modeling topics include gravitational and orbital motions, various physics phenomena such as vibrations and waves, dissipation and diffusion, buckling and bending, finally spring and mass systems. Depending on the class, models from biology, social science and economy may also be addressed.

### Text

Komzsik L.: Applied calculus of variations for engineers, 2nd edition; CRC Press, 2014

### Prerequisites

Linear algebra (3A), ordinary differential equations (3D), partial differential equations (112).

### Schedule

Week	Topics	Text
1	Modeling and calculus of variations	1.1, 1.3, 2.2, 2.3
2	Higher order and approximate models	4.1, 7.2, 9.1
3	Modeling gravity	1.4, 2.3
4	Orbital models	3.1-3.3, 10.5
5	Buckling and bending	11.3
6	Vibrations and waves	11.1-11.2
7	Dissipation and diffusion	12.3
8	Springs and masses	10.2-10.3, 12.5
9	Population dynamics	* 11.2
10	Economical growth	* 13.1-2

\* Recommended: Wan, F. Y. M.: Mathematical models and their analysis, SIAM, 2018