

# Mechanical vibrations

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## **Single degree of freedom systems** (chp. 3, chp 1,2,3).

Free vibration, forced vibration, frequency response function, harmonic excitation, periodic excitation.

## **Multi degrees of freedom systems** (chp. 4,5; chp 5,6 ).

Free vibration of 2 and N degrees of freedom system. Mass, stiffness, damping matrices. Rigid body modes. Orthogonality of eigenvectors. Modal decoupling. Forced vibration, frequency response function

## **Continuum systems**(chp 6,7; chp 8;).

Free vibration of beams (flexural and axial) .

## **Numerical methods in dynamic analysis** (chp 8; chp 12;).

- Rayleigh-Ritz method.

-Finite element method.

-FEM Software: MSC. Nastran and MSC. Patran. Exercises in lab..

## **Frequency analysis of signal** (chp. 9; chp10).

Fourier theory, signal types.

## **Measuring vibration** (chp. 9,10; chp 10).

Accelerometer, experimental modal analysis: theory and practice.

## **Rotordynamics** (chp. 13; chp 10).

**Exercises.** A number of exercises have to be done for the final exam. During the lessons, the lecturer will give details about this.

## **Books**

- Meneghetti, Maggiore, Funaioli, *Lezioni di meccanica applicata alle macchine. Vol. 3: Dinamica e vibrazioni delle macchine*, Pàtron, 2010.
- Rao, *Mechanical Vibrations*, 4<sup>th</sup> ed., New York, Addison-Wesley, 2004
- Thomson W., *Theory of Vibration with Applications*, 4th edition, New York, Chapman & Hall, 1993.