

תשפ"ב סמסטר ב' דינמיקת המבנים - 0540-6410-01 - Structural Dynamics

Lecturer: Prof. Slava Krylov

Classes: Monday 16⁰⁰-19⁰⁰ Room 210 Dan David Building for Mechanical Engineering

Hours: after the class or by appointment

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Grades: Homeworks - 30% Final Exam - 70%

References :

1. R.W. Clough and J. Penzien, *Dynamics of Structures*, McGraw-Hill, 1975
2. R.R. Craig, *Structural Dynamics. An Introduction to Computer Methods*, John Wiley&Sons, 1981
3. M. Geradin, D. Rixen, *Mechanical Vibrations. Theory and Application to Structural Dynamics*. Wiley 1997
4. L. Meirovitch, *Analytical Methods in Vibrations*, The Macmillian Company, 1967
5. L. Meirovitch, *Computational Methods in Structural Dynamics*, Sijthoff&Noordhoff, 1980
6. L. Meirovitch, *Fundamentals of Vibrations*, McGraw-Hill, 2001

Syllabus :

Introduction to structural dynamics. Vibrations of single DOF systems: free vibrations of undamped and damped system, response to harmonic excitation, response to general loading. Undamped vibrations of multiple DOF systems: free vibrations, natural frequencies and natural modes, response to general loading, modal analysis. Damped vibrations of multiple DOF systems, modal damping assumption (Rayleigh damping). Elements of analytical dynamics, variational formulation in dynamics: virtual work principle, kinematic constraints, generalized coordinates, Hamilton's principle and Lagrange's equation. Continuous systems: rods, beams, thin plates. Application of Hamilton's principle. Examples: beams Euler-Bernoulli and Timoshenko, beams on elastic foundation, effect of axial forces on beam's vibration, vibration of rotating beams, stability of rotating shafts, tubes with flowing fluid. Order reduction techniques, approximation of continuous systems: Rayleigh's-Ritz method, assumed modes method, Galerkin's method. Structural connections, direct stiffness method, consistent and lumped formulations, condensation. Direct time integration methods for dynamic response: basic formula for time integration, central differences, explicit and implicit algorithms, stability and accuracy, one-step formulas, Newmark's family. Solution methods for the eigenvalue problem: classification of solution methods, methods based on the determinant evaluation, matrix iteration methods, matrix transformation methods.