- **Course Number and Title:** M E 512. Vibrations
- **Catalog Description:** Free and forced vibrations for discrete and continuous systems with single or multiple degrees of freedom. Introduction to nonlinear and random vibration and solution techniques for such systems.
- **Credit Hours:** 3 Credits (3)
- **Prerequisite(s) / Corequisite(s)** Prerequisite(s): (M E 332 and M E 511) or Consent of Instructor
  Corequisite(s): None
- **Required:** Graduate Core
- **Course Availability:** Spring Semester
- **Instructor (Usual):** Dr. Abdessattar Abdelkefi (See https://mae.nmsu.edu/people/faculty.html)
- **Textbook:**
  1) W. T. Thomson and M. D. Dahleh, Theory of Vibration with Applications, 5th ed., Prentice Hall
  2) S. S. Rao, Mechanical Vibrations, 4th ed., Prentice Hall
  3) L. Meirovitch, Elements of Vibration Analysis, 2nd ed., McGraw-Hill
  4) A. H. Nayfeh, Problems in Perturbations, John Wiley & Sons, Inc.
- **Course Learning Objectives:**

  After completing this course, a student should be able to:
  1) Derive equations of motion of single- and multi-degree-of-freedom (DOF) systems
  2) Analyze free and forced vibrations of single- and multi-DOF systems
  3) Perform modal analysis of single- and multi-DOF systems
  4) Derive equations of motion of continuous systems including beams, strings, and rods
  5) Solve the governing equations of motion for several dynamical systems.
- **Topics Covered:**
  - Derivation of equations of motion
  - Free vibrations of SDOF systems
  - Forced vibrations of SDOF systems
    - Harmonic / base excitations
    - Rotating unbalance
    - Arbitrary excitation
  - Undamped free vibrations of 2-DOF systems
    - Natural frequencies / mode shapes
    - Beat phenomenon / normal modes
    - Orthogonality of modes
  - Forced vibrations of 2-DOF systems
    - Vibration absorber
  - Normal mode vibrations of MDOF
    - Orthogonality of modes

- Superposition method
- Continuous systems
  - Principle of virtual work
  - Hamilton’s principle
  - Vibrations of beams
  - Vibrations of strings
  - Vibrations of rods
- Solution techniques
  - Closed-form solutions
  - Perturbation techniques