

ME 3220 – Mechanical Vibrations

Credits and Contact Hours: 3 Credits. Three 50-minute or two 75-minute lectures per week.

Instructors: Chengyu Cao, George Lykotrafitis, Nejat Olgac, Jiong Tang,

Textbook: *Engineering Vibrations*, by D. Inman, Prentice Hall, 2001.

Specific Course Information:

- a. Catalog Description: Free and forced vibrations, with damping, of linear systems with one and two degrees of freedom. Transient vibrations. Vibration isolation. Rigid rotor balancing. Elements of Laplace transforms.
- b. Prerequisites: ME 3253, MATH 2110Q, MATH 2410Q, and CE 2120
- c. Required, Elective or Selected Elective: Required

Specific Goals:

a. Course Outcomes:

After completing ME 3220 students should be able to:

1. Construct the equation of motion from free-body diagrams.
2. Solve for the motion and the natural frequency of a freely vibrating single degree of freedom undamped system.
3. Solve for the motion of a freely vibrating single degree of freedom damped system under different damping ratios.
4. Solve the harmonic response of a single degree-of-freedom (undamped or damped) system, and to put together the complete solution. Analyze the frequency response.
5. Decompose any periodic excitation into a series of simple harmonic motions using Fourier analysis and obtain the corresponding response for single degree of freedom system.
6. Analyze impulse response for single degree-of-freedom system.
7. Solve the response of a single degree of freedom system subjected to arbitrary input using Duhamel integral.
8. Solve the natural frequencies and mode shapes of system with multiple degrees of freedom.

b. Relationship of Course Outcomes to Criterion 3 Student Outcomes:

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.
Students learn to identify, formulate and solve basic engineering problems using the fundamental principles of mechanics and mathematical approximation. This course requires students to apply knowledge of mathematics, science and engineering to the solution of practical linear mechanical vibration problems
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.
Students use the fundamental principles of mechanics to examine the performance

of a mechanical system and redesign the system to improve its response characteristics.

3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Not Applicable

4. An ability to communicate effectively with a range of audiences.

Not Applicable

5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

Not Applicable

6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.

Students learn to use numerical, mathematical and presentation tools in the solution of practical engineering problems, and have relevant software packages available for use in completing work.

7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

Not Applicable.

Topics Covered:

- ♦ Review of 2nd order ODE's, linearity solution methods
- ♦ Single degree of freedom oscillators
- ♦ Two degrees of freedom oscillators
- ♦ Effective springs and masses
- ♦ Transient vibrations
- ♦ Impulse response
- ♦ Solutions to differential equations
- ♦ Modal analysis
- ♦ Vibration absorption
- ♦ Measurement of frequencies