Syllabus

Course Name Mechanical Vibration

Course Number ENG ME 441

Semester Spring 2022

Course Description One- and multi-degree-of-freedom systems. Natural frequencies and modes of vibrations, resonance, beat phenomenon. Stability analysis. Energy methods. Applications to rotating machinery. Methods for vibration reduction.

Prerequisite ENG ME 302

Required Course Materials *Mechanical Vibrations*, Sixth Edition, Singiresu S. Rao.

Required Course Software Matlab

Recommended Course Equipment 0.9 mm Pentel GraphGear 500 Automatic Drafting Pencil Gray (PG529N) with 2B lead

Lectures Lectures are held in PHO 201 on Mondays and Wednesdays, 3:30 p.m. – 5:15 p.m.

Access to Live and Recorded Lectures You are expected to attend lectures in person. You are allowed to access 3 lectures remotely, either live or recorded or both. These are intended to support learning if you are ill or have other legitimate reasons for not attending in person. To access a live lecture on Zoom, simply join using the Zoom links on Blackboard. To access a recorded lecture, send a request by email to the instructor. You are not required to state the reason in the email. If more than 3 are necessary, please email the instructor and explain the reason.

Instructor Professor J. Gregory McDaniel

Instructor Email `jgm@bu.edu`

Grader Luis Souza

Grader Email `luisdhvs@bu.edu`

Office Hours By appointment. To arrange an appointment, email at least two suggested times and a summary of your questions.

Accommodations for Students with Documented Disabilities If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures at `http://www.bu.edu/disability/accommodations/`.

Course Average The numerical course average will be an average of 10 assignments.

Course Grade The letter grade for the course will be determined from the following chart:

Percent Range	Letter Grade
92.5–100	A
90.0–92.5	A-
87.5–90.0	B+
82.5–87.5	B
80.0–82.5	B-
77.5–80.0	C+
72.5–77.5	C
70.0–72.5	C-
60.0–70.0	D
50.0–60.0	F

Collaboration Policy on Assignments Students are allowed to discuss the assignments with each other and help each other learn. However, each student must turn in a code that they wrote. Students are not allowed to share their code in any way.

- Code may not be electronically transmitted in any format.
- Code may not be posted online.
- Code may not be printed out and given to another person.
- Code may not be visually seen by another person, either on a screen or on paper.
- Code may not be read aloud to another person.
- Code cannot be communicated in any way to another person.

No portion of any assignment may be posted online. If identical portions of codes are found, that will be considered a violation of the academic conduct code and referred to the university for investigation.

Grading Concerns All grading concerns must be reported to the professor within one week of returning the graded work.

Lecture Topics

1.4 Basic Concepts of Vibration

1.5 Classification of Vibration

1.6 Vibration Analysis Procedure

1.7 Spring Elements

1.8 Mass or Inertia Elements

1.9 Damping Elements

1.10 Harmonic Motion

1.11 Harmonic Analysis

2.1 Introduction to Free Vibration of Single-Degree-of-Freedom Systems

2.2 Free Vibration of an Undamped Translational System

2.3 Free Vibration of an Undamped Torsional System

2.4 Response of First-Order Systems and Time Constant

2.5 Rayleigh's Energy Method

2.6 Free Vibration with Viscous Damping

3.1 Introduction to Harmonically Excited Vibration

3.2 Equation of Motion

3.3 Response of an Undamped System Under Harmonic Force

3.4 Response of a Damped System Under Harmonic Force

3.5 Response of a Damped System Under $F(t) = F_0 \exp(i\omega t)$

3.6 Response of a Damped System Under the Harmonic Motion of the Base

3.7 Response of a Damped System Under Rotating Unbalance

3.8 Forced Vibration with Coulomb Damping

3.9 Forced Vibration with Hysteresis Damping

3.10 Forced Motion with Other Types of Damping

3.11 Self-Excitation and Stability Analysis

4.2 Response Under a General Periodic Force

4.3 Response Under a Periodic Force of Irregular Form

4.4 Response Under a Nonperiodic Force

4.5 Convolution Integral

4.6 Response Spectrum

4.7 Laplace Transforms

5.1 Introduction to Two DOF Systems

5.2 Equations of Motion for Forced Vibration

5.3 Free-Vibration Analysis of an Undamped System

5.4 Torsional System

5.5 Coordinate Coupling and Principal Coordinates

5.6 Forced Vibration Analysis

5.7 Semidefinite Systems

5.8 Self-Excitation and Stability Analysis

5.9 Transfer-Function Approach

5.10 Solutions Using Laplace Transform

5.11 Solutions Using Frequency Transfer Functions