Course Information
Mechanical Vibrations
ENG ME 441
Fall 2011

Course Description

One- and multi-degree-of-freedom systems. Natural frequencies and modes of vibrations, resonance, beat phenomenon, effect of damping, applications to practical problems, and methods to avoid excessive vibrations. Lagrange's equations.

Learning Outcomes

i. Become proficient in the modeling and analysis of one-dof-systems - free vibrations, transient and steady-state forced vibrations, viscous and hysteric damping. (A, E, L)
ii. Become proficient in the modeling and analysis of multi-dof systems - Lagrange's equations, reduction to one-dof systems for proportionally damped systems, modal analysis, vibration absorbers, vibration transmission, Fourier transforms. Use of Matlab for matrix computations and Fourier analysis. (A, E, K, L)

Prerequisite

ENG ME 302: Engineering Mechanics II

Lectures

Lectures are held in PHO 201 on Mondays and Wednesdays from 10:00 a.m.–12:00 p.m. You are strongly encouraged to ask questions during lecture and to offer answers to questions asked by the professor, even if you are not sure they are correct. Attendance will be taken at these lectures and used as one indicator of your level of effort. Ringers on cell phones should be turned off during lecture.

Discussion Section

You are required to register for the discussion section (B1). The discussions will be held occasionally in PHO 201 on Mondays from 8.–9 p.m. If a discussion is not announced in lecture, then assume that it will not be held.

Instructor

- Professor J. Gregory McDaniel
- Email: jgm@bu.edu
- Office Location: Room 406 of 110 Cummington Street
- Office Phone Number: 617.353.4847
- Home Phone Number: 781.861.0202
- Office Hours: Mondays 3:00–4:00 p.m. or by appointment. To arrange an appointment, email at least two suggested times and a summary of your questions.

Teaching Fellow

- Sai Krishna Nanduri
- Email: krisna@bu.edu
- Office Location: TBA
- Office Hours: TBA

Course Materials

- Required Text: *Mechanical Vibrations, Fifth Edition*, Singiresu S. Rao, ISBN 0132128195.
- Supplementary Text: *Mechanical and Structural Vibrations, First Edition*, Jerry H. Ginsberg, ISBN 0-471-12808-2.

Grading

Your final course grade is calculated according to the following distribution:

- Quizzes: 40%

- Midterm Examination: 30%
- Final Examination: 30%

Quizzes

Quizzes will be given roughly once a week. The lowest quiz grade will be dropped.

Midterm Examination

The midterm examination will be given in class on Wednesday, October 19.

Final Examination

The final examination is tentatively scheduled for Saturday, December 17, 3:00p.m. - 5:00p.m. Early examinations will not be given.

Missed Quizzes and Examinations

Here is the policy regarding a missed event (i.e. quiz or examination):

- If you know ahead of time that you will miss the event, you must notify the instructor by email and describe your reason for missing the event.
- If the instructor determines that the reason is appropriate, you will be excused from the event and the grade will not count in determining your course grade. If the instructor determines that the reason is not appropriate, you will receive a zero for that event.
- The following reasons are not appropriate: oversleeping, working on an assignment for another course, travel for pleasure.
- If you do not know ahead of time that you will miss the event, you must notify the instructor in writing as soon as possible after the event and describe your reason for missing the event.

Withdrawals, Drops, and Incompletes

Please see the important dates listing from the University Registrar. These will be strictly enforced. Incompletes will be permitted only for extenuating circumstances and they must be arranged before the final examination.

Syllabus
Mechanical Vibrations
ENG ME 441
Fall 2011

References in parentheses refer to *Mechanical Vibrations*, Singiresu Rao, Fifth Edition.

1. Vibrational elements, problem classification (Sections 1.4–1.9)
2. Harmonic motion (Sections 1.10–1.11)
3. Free vibration of undamped single DOF[1] systems (Sections 2.1-2.3)
4. Stability, Rayleigh's Energy Method, stability (Sections 2.4–2.5)
5. Free vibration of viscously damped SDOF systems (Sections 2.6)
6. Free vibration of damped SDOF systems with Coulomb and hysteretic damping (Sections 2.7–2.8)
7. Harmonically forced SDOF systems (Sections 3.1–3.5)
8. Harmonic motion of the base, rotating unbalance (Sections 3.6–3.7)
9. Forced vibrations of Coulomb-damped and hysteresis-damped SDOF systems, self-excited vibrations (sections 3.8–3.11)
10. Periodically forced vibrations (4.2–4.3)
11. Non-periodically forced vibrations (4.4–4.5)
12. Response spectrum, Laplace transforms (4.6–4.7)
13. Free vibration of 2 DOF systems (Sections 5.1–5.5)
14. Forced vibration of 2 DOF systems (Sections 5.6–5.8)

[1] Degree(s)-Of-Freedom

15. Equations of motion for MDOF systems (Sections 6.1–6.4)
16. Equations of motion for MDOF systems (Sections 6.5–6.8)
17. Eigenvalue problem for free vibration of MDOF (Sections 6.9–6.13)
18. Forced vibrations of MDOF systems using modal analysis (6.15)
19. Forced vibrations of viscously damped MDOF systems (Section 6.14)
20. Rayleigh's Method (Section 7.3)
21. Longitudinal and torsional vibrations of bars (Sections 8.3–8.4)
22. Nonlinear vibration (Section 13.2, 13.3)
23. Nonlinear vibration (Section 13.4)