ME/MFS 513 – Section 201 (ME 498 at WKU)
Mechanical Vibration
Fall 2018 - Online Course

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Course Description:
The analysis of vibrational motion of structural and mechanical systems. Single-degree-of-freedom systems; free vibrations; nonperiodic excitation; harmonic excitation. Modal analysis of multiple-degree-of-freedom systems. Vibration of continuous bodies, including strings and bars (axial, torsional and flexural modes). Energy methods. (Same as EM 513.)

Prerequisites:
EM 313 and EM 302, engineering standing or consent of instructor.

Student Learning Outcomes:
After completing this course, the student will be able to:

1. Define and understand basic vibration terminology, such as “periodic motion”, “logarithmic decrement”, etc.
2. Calculate the free response, forced response (primarily assuming sinusoidal forcing), and transient response of structures, through hand calculations for small system models, and through computer simulations for larger system models.
3. Understand the effect of system structural parameters (mass, stiffness, and damping) on the system free response and forced response.
4. Understand the concept of multiple natural frequencies for a multi-dof system, and the meaning of a mode shape.

5. Find exact solutions, using partial differential equations, for continuous system models of string vibration, longitudinal vibration of rods, torsional vibration of rods, and lateral vibration of beams.
6. Understand some of the basic aspects of modal testing.
7. Use modern engineering tools, such as MATLAB and ANSYS, to predict vibration characteristics of physical systems.

Required Materials:

The required textbook is:
Inman, Daniel J., Engineering Vibration, Fourth Edition, Pearson Education, Inc., Upper Sadle River, New Jersey, 2014, ISBN-13: 978-0132871693, ISBN-10: 0132871696

Description of Course Activities and Assignments

Notes Regarding Online Implementation of the Course:

- All information on the course will be maintained on the University of Kentucky's Canvas Learning Management System (LMS). The course information will include lecture videos, lecture notes, course assignments, quizzes, grades, and other documents. This course is delivered in a web-based format, and it is essential that students stay current with the material. Videos of lectures will be posted for viewing by students based on the weekly schedule provided at the end of this syllabus.

- Assistance with questions on the course material will be provided through email, phone/text, personal meetings (by arrangement), and online sessions. Online help sessions will be scheduled on a weekly basis at times TBA. Instructions for connecting to online help sessions will be provided on Canvas. Additional sessions can be arranged on request.

- The course content is arranged in modular form, under the "Modules" tab in Canvas. The UK Canvas LMS can be accessed at https://www.uky.edu/canvas/.
  Students enrolled in the course should be automatically included for access and should be able to log in using their UK Link Blue ID's and passwords. Be sure to verify LMS access during the first two days of the semester.

- It is essential that students check email on a daily basis. The email address on Canvas will be used by default, so students must activate email forwarding if they prefer another primary email address.

- Students are expected to take proctored exams. For the convenience of students on the UK Lexington and Paducah campuses, and on the WKU campus, an exam room will be provided. Exam times and locations are TBA. Students who cannot come to either campus for exams will need to arrange a proctored site convenient to them or arrange for an online proctoring service. These remote proctoring services may require a fee to be paid by the student.

Course Assignments

Note: See the grade distribution in the "Course Grading" section.
2 Exams at 100 points each
12 graded homework assignments at 100 points each
12 online quizzes at 100 points each
1 graduate student project, graded on a 100-point basis

Summary Description of Course Assignments

Homework:
There will be 12 total homework assignments. Each will be graded on a 100-point basis, so each assignment carries equal weight. Some assignments will require use of engineering software tools, such as MATLAB and ANSYS. Sufficient instruction on use of these tools will be provided. These software packages are available for student use in the engineering computer labs on the main campus in Lexington and at the extended campus program in Paducah. Student editions are also available. Information on the obtaining student editions of these software packages will be provided on Canvas. The homework contribution to the total course grade is outlined below. Homework assignments will be submitted in electronic form to the Canvas Learning Management System.

Homework assignments will be due on Fridays at 5:00 pm eastern time. If an assignment is submitted after the time it is due, but it is submitted by the following Monday at 5:00 pm eastern time, the student will receive half credit. In other words, the submitted work will be graded as if submitted on time, and then the score will be multiplied by 0.5. For example, if an assignment is submitted after 5:00 pm eastern time on the Friday it is due, but before 5:00 pm eastern time on the following Monday, and if the graded homework results in a score of 84, then a score of 42 will be entered. Homework submitted after 5:00 pm on the Monday following the Friday that it was due will receive a score of zero. Of course, if a student has a valid excuse for being late, exceptions may be made to this homework grading policy.

Quizzes:
There will be 12 quizzes, each graded on a 100-point basis, so each quiz carries equal weight. These will be taken online in the Canvas Learning Management System, and will

relate primarily to the recorded lecture material. They are due on Wednesdays at 11:59 pm eastern time, except Quiz 1 which is due Friday, 8/31, at 5:00 pm eastern time. A grade of zero will be entered for quizzes that are not completed by the time they are due. Of course, if a student has a valid excuse for being late, exceptions may be made to this quiz grading policy.

Exams:

There will be two exams: a midterm exam and a comprehensive final exam. The exams will be closed book. You will have two hours to complete each exam. You may be provided some reference materials for exams, and/or you may be told to bring some reference materials to the exam. You will be told via an announcement posted on Canvas at least two weeks in advance of each exam what materials will be available to you during the exam. Exams will each be graded on a 100-point basis. The midterm exam during the semester is worth 35% of the total course grade, as shown below. The comprehensive final exam during finals week at the end of the semester is worth 40% of your total course grade.

Graduate Student Project / Homework:

Students taking the course for graduate credit will be required to complete a graduate student project which the undergraduate students will not complete, and 5% of their course grade will be based on the graduate student project. It will require a written report to be submitted electronically on Canvas by 5:00 pm on Friday, December 7, 2018. Graduate students will have a smaller percentage of their grade than undergraduates from the "Homework" and "Quiz categories. They will, however, complete the same homework assignments the undergraduate students complete. Also, for some homework assignments, there will be an additional "graduate student only" portion.

Extra Credit in Homework/Quiz Category for Class Participation

Students will have the opportunity to improve their grade in the Homework/Quizzes category by participation in the Canvas Discussion board. More information will be provided in the Canvas Discussion Board.

To calculate the grade in the Homework/Quizzes category, the total quiz points and homework points are added. Therefore, there are 2400 points possible for this category, with 1200 from quizzes and 1200 from homework. Students can earn up to 200 extra credit points for this category through class participation. However, if the total points accumulated plus extra credit points exceeds 2400, then the total points accumulated will be taken to be 2400. In other words, the average in this category will not be calculated at above 100% for purposes of calculating the final course average.

Course Grading:

(i) Grading scale and grade distribution:

Undergraduate Students

Grading Scale:

90%-100%	A
80%-89.9%	B
70%-79.9%	C
60%-69.9%	D
0%-59.9%	E

Grade Distribution:

Homework/Quizzes	25%
Midterm Exam	35%
Final Exam	40%

Graduate Students

Grading Scale:

90%-100%	A
80%-89.9%	B
70%-79.9%	C
0%-69.9%	E

Note: A "D" is not a valid grade for students taking a course for graduate credit.

Grade Distribution:

Homework/Quizzes	20%
Project	5%
Midterm Exam	35%
Final Exam	40%

(ii) Expectations for graduate students beyond the expectations for undergraduates:

See the information under the subheading, "Graduate Student Project / Homework". Also, note the differences in the grade distribution between undergraduate students and graduate students.

Final Exam Information

Because this is an online course, there is not a specific university-designated time for the final exam. A final exam time and place will be arranged upon consulting with the enrolled students. For students on the Lexington campus and the WKU campus, it will occur during the university-designated finals week, which is December 10 through December 14. For students on the Paducah campus, it will occur during the designated finals week, which is December 3 through December 7.

Mid-term Grade:

Mid-term grades for UK undergraduate students will be posted in MyUK by the deadline established in the Academic Calendar which is October 22, 2018. (http://www.uky.edu/registrar/fall-2018-semester)

Course Policies:

Submission of Assignments:
Scanned copies of homework assignments are to be submitted using the assignment submittal feature in Canvas. Homework to be submitted must meet the following guidelines for full credit to be given:

1. Use standard 8.5"x11" paper, lined or unlined, or prepare within a word-processing program.

2. Handwritten material must be legible when scanned. Use a suitably dark pen or pencil, and scan to pdf. Do not submit a camera photo unless it is clearly legible.

3. Each assignment is to be submitted on Canvas as a single file (merge multiple files, if necessary), preferably in PDF or Microsoft Word format. If any additional files are required for a specific assignment, this will be stated in the homework assignment document posted on Canvas.

Attendance Policy:
Because this is an online course, regular class attendance is not required.

Excused Absences (boilerplate)

Students need to notify the professor of absences prior to class when possible. *Senate Rules 5.2.4.2* defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud (859-257-3737, http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php.

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused) per University policy.

Per *Senate Rule 5.2.4.2*, students missing any graded work due to an excused absence are responsible: for informing the Instructor of Record about their excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The professor must give the student an opportunity to

make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred.

Verification of Absences (boilerplate)

Students may be asked to verify their absences in order for them to be considered excused. *Senate Rule 5.2.4.2* states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness, or death in the family. Appropriate notification of absences due to University-related trips is required prior to the absence when feasible and in no case more than one week after the absence.

Academic Integrity (boilerplate)

Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the University may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Senate Rules 6.3.1 (see http://www.uky.edu/Faculty/Senate/ for the current set of *Senate Rules*) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. Students

may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone.

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations due to disability (boilerplate)

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at drc@uky.edu. Their web address is http://www.uky.edu/DisabilityResourceCenter.

If any students have any questions about this issue, please contact the instructor as early in the semester as possible.

Tentative Course Schedule

Week	Dates	Primary Topics	Homework / Quiz Due Dates
1	8/22 - 8/26	Course Introduction, Translational Single DOF Systems: Undamped Free Vibration	
2	8/27 - 9/2	Single DOF Systems: Translational and Rotational Systems, Viscous Damping, Logarithmic Decrement for Estimating Damping	Quiz 1: 8/31 Homework 1: 8/31
3	9/3 - 9/9	Single DOF Systems: Harmonic Response	Quiz 2: 9/5 Homework 2: 9/7
4	9/10 - 9/16	Single DOF Systems: Estimation of Damping from Harmonic Response Results, Fourier Series Analysis, Steady-State Response to Rotating Unbalance	Quiz 3: 9/12 Homework 3: 9/14
5	9/17 - 9/23	Single DOF Systems: Transfer Functions, Steady-State Response to Support Motion Excitation. Response to Nonperiodic Excitations, such as Step Inputs, Impulses, etc.,	Quiz 4: 9/19 Homework 4: 9/21
6	9/24 - 9/30	Multi-DOF Systems: Undamped Natural Frequencies and Mode Shapes	Quiz 5: 9/26 Homework 5: 9/28
7	10/1 - 10/7	Multi-DOF Systems: Harmonic Response Analysis, Damping Effects, Vibration Absorbers	Quiz 6: 10/3 Homework 6: 10/5
8	10/8 - 10/14	Multi-DOF Systems: State Variable Form of System Equations, Simulating System Response with MATLAB/Simulink, Midterm Exam – Two Hour Exam – Times and locations to be arranged. Announcement with proposed times to be posted on Canvas by 8/23. Exam covers all Material thru Quiz 6/HW6.	
9	10/15 - 10/21	Multi-DOF Systems: Uncoupled Equations	Quiz 7: 10/17 Homework 7: 10/19
10	10/22– 10/28	Multi-DOF Systems: Response Solutions Using Uncoupled Equations, Numerical Integration,	Quiz 8: 10/24 Homework 8: 10/26
11	10/29- 11/4	Energy Methods, Finite Element Method	Quiz 9: 10/31 Homework 9: 11/2
12	11/5 – 11/11	Partial Differential Equation Solutions for Vibration of Continuous Systems – Strings, Rods	Quiz 10: 11/7 Homework 10: 11/9
13	11/12- 11/18	Partial Differential Equation Solutions for Vibration of Continuous Systems – Beams	Quiz 11: 11/14 Homework 11: 11/16
14	11/19- 11/25	Experimental Modal Testing	
15	11/26- 12/2	Testing of Structures and Comparison to Finite Element Analysis Results from ANSYS/Workbench	Quiz 12: 11/29 Homework 12: 12/1
16	12/3 - 12/7	UK-Paducah Comprehensive Two-Hour Exam - Times and locations to be arranged. Announcement with proposed times to be posted on Canvas by 8/23.	Grad Student Proj: 12/7
	12/10- 12/14	UK-Lexington and WKU Final Exam – Comprehensive Two-Hour Exam - Time and location to be arranged. Announcement with proposed time to be posted on Canvas by 8/23.	