TEXAS A&M UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
FALL 2017

MEEN 363, Section 503 Dynamics and Vibrations

Dynamics and Vibration. Application of Newtonian and energy methods to model dynamic systems (particles and rigid bodies) with ordinary differential equations; solution of models using analytical and numerical approaches; interpreting solutions; linear vibrations. Three credit hours (2-2).

Instructor:

Won-jong Kim, PhD
Associate Professor
223 Mechanical Engineering Office Building
(979)845-3645, phone
wjkim@tamu.edu, e-mail
http://alum.mit.edu/www/wjkim, webpage

TA:

Brady Reed
brady_reed@tamu.edu, e-mail

Grader:

Crystal Nguyen
crystalnguyent@tamu.edu, e-mail

Lectures:

MW(F) 10:20 AM–11:10 AM at 202 ENPH
TAMU was closed on Monday, August 28 due to Hurricane Harvey, and the lecture was canceled. A make-up lecture will be held on Friday, September 15.

Recitations:

M 5:45 PM–7:35 PM at 208 SCTS
To make up for the canceled recitation on August 28, evening recitations will be extended to 7:50 PM for eight weeks.

Office Hours:

Dr. Kim: M 3:30 PM–4:30 PM and W 1:30 PM–2:30 PM at 223 MEOB or by appointment
TA: T: 4–5 PM and R 1–2 PM at 012 RDMC or by appointment

Learning Outcomes and Course Objectives:

- Application of Newtonian and energy methods to model dynamic systems (particles and planar rigid bodies) with ordinary differential equations
- Solution of models using analytical and numerical approaches; interpreting solutions
- Linear one-degree-of-freedom and two-degree-of-freedom vibrations

On-Line Course Materials:

A course web page is being established at eCampus.tamu.edu. You should be able to access the web page if you are registered for the course. All course-related material you will need, e.g. homework sets, Matlab handouts, solutions, and other useful materials will be placed. Supplementary materials created by Dr. San Andres are also posted.

Text (required):

- D. Childs and A. P. Konkey, *Dynamics in Engineering Practice*, 11th Ed., CRC Press, 2015.

References:

- J. L. Meriam and L. G. Kraige, *Dynamics*, 6th Ed., Wiley, 2006.
- W. T. Thomson and M. D. Dahleh, *Theory of Vibrations with Applications*, 5th Ed., Prentice Hall, 1998.
- J. H. Ginsberg, *Advanced Engineering Dynamics*, Cambridge University Press, 1995.

Prerequisites:

- Engineering Mechanics (MEEN 225)
- Differential Equations (MATH 308)
- Engineering Analysis for Mechanical Engineers (MEEN 357) or concurrent enrollment.
- Mechanics of Materials (CVEN 305) or concurrent enrollment.

Grading:

- Four mid-term exams—160 each
- Final exam—200
- Assignments—160
  - Six homework sets
  - Up to nine MATLAB assignments
- Total/10 = Course numerical grade from 0 to 100.
  - A: greater than 90
  - B: greater than 80 and less than 90
  - C: greater than 70 and less than 80
  - D: greater than 60 and less than 70
  - F: less than 60

Exam Schedule:

- Exam 1: Thursday, September 21 (7–9 PM) at TBA
- Exam 2: Thursday, October 5 (7–9 PM) at TBA
- Exam 3: Thursday, October 19 (7–9 PM) at TBA
- Exam 4: Thursday, November 9 (7–9 PM) at TBA
- Final Exam: Tuesday, December 12 (8–10 AM) at 202 ENPH

All exams are closed books, closed notes. No electronic device except a calculator is allowed.

Policy on Grading Complaints:

If you feel a mistake was made in grading any material, please first contact the person doing the grading within a week after the graded paper is distributed. Then the grader will review all problems in your exam. Thus, depending on the review results, your exam score can increase or decrease. If you are not satisfied with the resolution of the matter then talk to me. *After the one week discussion period, we will not review your exams or change grades.* Make your complaint to me in writing and via e-mail. Be specific about your complaints. Please note I do not negotiate my partial-credit policy with students.

Absences:

Work missed due to absences will only be excused for University-approved activities in accordance with TEXAS A&M UNIVERSITY STUDENT RULES (see http://student-rules.tamu.edulrule7.htm). Specific arrangements for make-up work in such instances will be handled on a case-by-case basis. In accordance with recent changes to Rule 7, please be aware that in this class any "injury or illness that is too severe or contagious for the student to attend class" will require "a medical confirmation note from his or her medical provider" even if the absence is for less than 3 days (see 7.1.6.2 injury or illness less than three days).

ADA Statement:

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room 126 of the Koldus Building or call 845-1637.

Academic Integrity:

Aggie Honor Code: *"An Aggie does not lie, cheat, or steal, or tolerate those who do."*

Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit: aggiehonor.tamu.edu

On all course work, assignments, and examinations at Texas A&M University, the following Honor Pledge shall be preprinted and signed by the student:

"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

_____

Signature of Student

Schedule:

Following is a tentative schedule. The pace will be adjusted as the semester progresses.

PART 1, Kinematics of Particles and Rigid Bodies (reading material—Sections 2.1–2.7, 4.1–4.5)

Wk. 1 Motion in a plane using Cartesian coordinates, matrix algebra, Cramer's rule, coordinate transformations. Polar coordinates. Path coordinates.

Wk. 2 Normal-Tangential coordinates. Moving between Cartesian, polar, and path coordinate results using coordinate transformations.

Wk. 3 Governing equation. Rolling without slipping.

Wk. 4 Planar kinematic examples.

PART 2, Particle Kinetics and 1-DOF Vibrations (reading material—Chapter 1 on units, Sections 3.1–3.2.5, 3.3.1)

Wk. 5 Newton's laws, constant acceleration, spring forces. 1-DOF undamped vibration, equilibrium, natural frequency, forced excitation.
MATLAB assignment 11 (slider crank) due Wednesday 9/27 (You may use EXCEL spread sheet.)

Wk. 6 1-DOF damped vibration example. The simple pendulum and linearization. Energy dissipation, viscous damping, damping factor, damped natural frequency, transient solution. Harmonic excitation, steady-state solution, base excitation.

Wk. 7 Excitation due to a rotating imbalance. Steady-state solution examples.
MATLAB assignment 1 (spring-mass-damper) due Wednesday 10/11

PART 3, 2-DOF Vibrations (reading material—Section 3.5)

Wk. 8 2-DOF vibration problems, spring-mass and double-pendulum examples. Eigenanalysis for 2-DOF vibration examples
MATLAB assignment 2 (simple pendulum) due Wednesday 10/18

Wk. 9 Free and forced harmonic motion for 2-DOF examples. Solving for motion using modal coordinates.
MATLAB assignment 9 (frequency response) due Wednesday 10/25

PART 4, Planar Kinetics, 1-DOF Systems (reading material—Sections 5.1–5.7.1)

Wk. 10 Planar mechanisms.
MATLAB assignment 8 (double pendulum) due Wednesday 11/1

Wk. 11 Inertia properties. Force and moment equations of motion. Kinetic energy of a rigid body.
MATLAB assignment 10 (three-bar linkage) due Wednesday, 11/8

Wk. 12 The compound pendulum. Compound-pendulum/spring-connection vibration examples. General motion/Rolling-without-slipping examples.
MATLAB assignment due on tortional pendulum due Wednesday 11/15

PART 5, Planar Kinetics for Multi-Body Systems (reading material—Sections 5.7.2–5.8)

Wk. 13 Examples having more than one degree of freedom.
MATLAB assignment 6 (Half cylinder rolling on a horizontal plane) due Wednesday 11/29

Wk. 14 2-DOF Torsional examples. 2-DOF examples with beam elements. Planar mechanisms.
MATLAB assignment 12 (A bar supported by a wire and a horizontal plane) due Wednesday 12/6