ME 464 – Intermediate Dynamics – Spring 2020

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Lectures: MWF from 3:00-3:50 in 1230 Engineering Building

Office hours: Dr. Khasawneh: (End on 2/28/2020)

M 9:00AM-10:00AM, F 11:00AM-noon, or by appointment

Dr. Recktenwald: TBD (Begin on 3/9/2020)

Website: Desire-to-learn (D2L.msu.edu) - Check for announcements, updates, & solutions.

Textbook(s): *Introductory Text: *Engineering Mechanics: Dynamics*, by R.C. Hibbeler Pearson

*Intermediate Text: [@]*Applied Dynamics*, by F. C. Moon ***required**

Other excellent texts: ([♯] on reserve at the Library) ([@]e-text @ lib.msu.edu)

Analytical Dynamics, by Haim Baruh
[♯]*Vector Mechanics for Engineers-Dynamics*, by Beer & Johnston
Applied Dynamics, by Haim Baruh
[♯]*Principles of Dynamics* AND [@]*Advanced Dynamics*, by Greenwood
Vibrations, by Thomson and Dahleh

Objectives: Upon completing this course you should be able to:

(1) Identify the forces acting on a system by the environment and draw a correct free body diagram.
(2) Apply Newton/Euler and/or Lagrangian methods to derive the equations of motion for the system.
(3) Analyze the equations and obtain solutions analytically when possible.
(4) Find solutions by numerical methods.
(5) Study the results and explain the implications for stability, dynamic loads, and other design issues.
(6) Make reasonable assumptions to simplify a mechanical system to the degree that it can be modeled by the principles of dynamics.

Office Hours: I am delighted to meet with students during office hours to clarify course issues and concepts. It is expected that students will give forethought to their questions prior to attending office hours. Don't be embarrassed to visit with a "simple" or "easy" question, often the answers to simple questions provide the most insight.

Examinations: All exams are closed-book, in-class exams. You may bring a single 3x5 notecard with formula and a calculator*. Make-up exams will be given only in the case of documented emergencies. Early exams will not be given.

Exam Schedule

Exam 1: Wednesday, Jan. 29th during class
Exam 2: Wednesday, Feb. 26th during class
Exam 3: Wednesday, Apr. 1st during class
Final: Wednesday, April 29th 5:45-7:45 pm

Homework: The importance of diligence on dynamics homework cannot be stressed enough!!! Homework will be assigned weekly and collected in class on Fridays. Solutions should be written clearly and methodically.

Late homework: Late homework may be turned in, but will be penalized at a daily rate of 10%. Late homework will be assigned an effort grade of 30% after solutions have been posted. Solutions to all problems will be posted on D2L.

Collaboration: Student collaboration on the homework is encouraged, but you must write up and submit your own solutions. Students are expected to fully work out all problems as they are an integral part of the learning experience.

Mini-Project / Mega-problem: Some homework assignments will have a problem that requires a more in-depth analysis. These projects will require you to use Matlab or Mathematica.

Exam Corrections: After exams 1, 2, & 3 you will correct the problem with the lowest score. Corrected solutions should be clearly written; like examples in the textbook. The exam corrections will count towards your homework score.

Grading: Your course grade is based on your in class grade total percentage. Your class grade will be based on 5 equally weighted components: Exam 1, Exam 2, Exam 3, Final, and Homework/Projects. I reserve the right to increase the weight of the final exam if it is in your best interests.

class total percent	≥90%	≥85%	≥80%	≥75%	≥70%	≥65%	≥60%	<60%
course grade	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0

Calculators: A calculator may be used on the exams, however calculators man NOT be shared. Only independent, non-networked calculators may be used on exams. No phones, tablets or computers may be used or present during the exams. Students should have an extra set of batteries for their calculator in their bag; extra time will not be provided if there is a calculator failure.

Electronics: Cellphones and computers can be distracting to yourself and other students. Recent research has shown the use of cellphones in class can lead to significantly lower course scores. Unless you receive prior permission to use them, they should remain silently in your bag.

Class Attendance: Absence from class can cause serious confusion; students are expected to attend lectures which are the standard forum for class communication. *Students are expected to prepare for class by reading the text material prior to class and*

examining the sample problems in the text. Class absence is not an excuse for being unaware of course announcements or course materials. Lecture notes should be obtained from a peer in the class, the instructor is not responsible for providing lecture notes due to a student's absence.

International Students: If English is not your first language you may find some of the terminology in this course confusing. Please speak up if something is not clear. Raise your hand for clarification during exams.

Communication: Email and other communication should comply with professional standards of corporate best practice. Use informative subject lines like "ME 464 question: HW 2 prob. 3".

Accommodations for Students with Disabilities: Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date may not be honored.

Ethics: Engineers must adhere to a rigorous code of professional ethics. Unethical conduct in ME464 will result in the maximum disciplinary action permitted by Michigan State University. Unethical conduct in this class includes, but is not limited to, cheating on exams and quizzes, and supplying information to others on exams and quizzes. Students bear due responsibility for ensuring the security of their examination work. There is a professional duty to report unethical conduct by others, including peers. If you have any questions, your instructor is available to discuss issues of professional expectations and ethics.

The Associate Students of Michigan State University (ASMSU) proudly launched the following Spartan Code of Honor academic pledge.

> **As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do." – Spartan pledge**

Software: Students should have access to Matlab and know how to use it. Matlab is available in all computer labs and is free to students through the bookstore.

Matlab Resources:

- MATLAB Onramp (free) on the MATLAB Academy site.
- MATLAB and Simulink Tutorials (free): Get started with the basics of MATLAB and Simulink.

- Getting Started with MATLAB (free): Documentation to introduce students to MATLAB.
- MATLAB Code Examples (free): Basic examples.
- MATLAB Examples (free): More MATLAB examples for a variety of applications.
- Cody (free): A social game intended to refresh and build students' MATLAB skills.
- Introduction to Programming with MATLAB : MOOC offered on the Coursera platform. This introductory programming class uses MATLAB as the language for implementation.

Spring 2020 – Intermediate Dynamics: Tentative Schedule

	Day	Date		Topics	Hibbeler	Moon	Homework
Kinematics & Frames of Ref.	1	1/6	M	Introduction		Chapter 1	
	2	1/8	W	Coordinate systems	12:1-8	2.2	
	3	1/10	F	Coordinate systems			HW01
	4	1/13	*M*	Translating coordinates	12:10	3.4	
	5	1/15	W	Rotating coordinates	16:8		
	6	1/17	F	Equations of motion (EOM)	16.5&7, 17:1-3		HW02
Kinetics	-	1/20	M	*MLK Day – No class*			
	7	1/22	W	EOM: The spherical pendulum	*Handout*		
	8	1/24	F	EOM: Four-bar linkage & piston	17:4-5		HW03
	9	1/27	M	The work energy equation	Ch18 (ref 14)		
Work & Energy	10	1/29	W	**Exam 1**			
	11	1/31	F	Power	14.4		HW04
	12	2/3	M	Equations of motion	22.2	2.4 (pg 59)	
	13	2/5	W	Momentum (Linear & Angular)	15.5-7,19:1-3	2.4	
Momentum & Impact	14	2/7	F	Fluid Flow	15.8		HW05
	15	2/10	M	Rockets (variable mass)	15.9		
	16	2/12	W	Kepler's Laws (I, II, & III)	13.7	7:1-2	
	17	2/14	F	Orbital Motion			HW06
	18	2/17	M	Impact (Eccentric)	15.4, 19.4		
	19	2/19	W	Projectile motion			
	20	2/21	F	Moment of inertia tensor	21.1	2.5	HW07
	21	2/24	M	Review			
	22	2/26	W	**Exam 2**			
	23	2/28	F	*Review of material*			HW08
Virtual Work & Lagranges equations	-			*Spring Break – No class*			
	24	3/9	M	Virtual displacements		2.3	
	25	3/11	W	Generalized Coordinates		4.1, 6.3	
	26	3/13	F	Lagrangian		4.2-3, 5.4, 6.4	HW09
	27	3/16	M	Constraints		2.6, 4.5	
	28	3/18	W	External Forces			
	29	3/20	F	Examples			HW10
	30	3/23	M	Virtual Power		2.7, 4.4, 5.5	
	31	3/25	W	Hamilton's Principle		4.6	
3-D Rigid Bodies Newton Euler	32	3/27	F	The Foucault pendulum	Ch 20		HW11
	33	3/30	M	Review			
	34	4/1	W	**Exam 3**			
	35	4/3	F	Matrix transformations	Handout	3.6-8, 5.1-2	HW12
	36	4/6	M	Newton-Euler	21.2&4	3.2, 5.3	
	37	4/8	W	Newton-Euler			
	38	4/10	F	Newton-Euler			HW13
	39	4/13	M	The spinning top	21.5-6		
	40	4/15	W	The Gyro			
	41	4/17	*F*	Lagrange in 3-D	21.3	5.4	HW14
	42	4/20	M	Lagrange in 3-D			
3-D Lagrange	43	4/22	W	Review for final exam			
	-	4/24	*F*	*Design Day – No class*			HW15
		4/29	**W**	**Final Exam – 5:45pm-7:45pm**			

1/31 - End of tuition refund period **2/26 – End of drop period.

This is a tentative schedule. Additional readings are available upon request.