Dynamics with Vibration

SECTION I: Course Overview

UNH Course Code: ENGR230
Subject Area: Engineering
Prerequisites: Introductory Physics, Statics, Calculus III (derivation, integration, and elements of vector calculus)
Language of Instruction: English
Contact Hours: 60
Recommended Credits: 4

COURSE DESCRIPTION

This course will guide students through Dynamics, the branch of Engineering Mechanics that deals with the movement of bodies subject to forces and constraints. The study of motion and its causes is developed in two stages, kinematics and kinetics. As a tool for Engineering, Dynamics will provide students with the methods to analyze and use physical laws in mechanical devices, such as the moving parts in an engine. The course includes basic elements of point particle physics, Newton's First, Second, and Third Law, the behavior of systems of point particles, collisions, and rigid systems. It also makes use of conservation laws, such as energy, momentum, and angular momentum conservation to predict system behavior.

Students will have the opportunity to discuss in physical and quantitative terms the motion of projectiles, of pendulums, of bodies subject to viscous drag, the functioning of mechanical devices, levers, and gearwheels.

The course has an added module that will expand study to mechanical vibrations. In this module students will study how to establish the equations for analyzing the vibrations of mechanical objects (particles and rigid bodies) by applying Newton's Laws as well as with the energy methods. Attention will also be given to the analysis of the free and forced mechanical vibrations with/without viscous damping, and an introduction to the particularities of nonlinear vibrations will also be presented.

LEARNING OBJECTIVES

- Recognize the fundamental physical laws used in kinematics and kinetics.
- Summarize the causal relation between forces and motion for point particles and rigid bodies.
- Demonstrate the role of vector analysis in simple mechanical systems.
- Apply a dynamical approach and perspective

- Differentiate the types of mechanical vibrations and analyze their response.
- Determine the vibration analysis by means of Newton's Laws and the energy methods.

SECTION II: Instructor & Course Details

INSTRUCTOR DETAILS

Name: TBD
Contact Information: TBD
Term: SUMMER

Class Meetings:

INSTRUCTIONAL FORMAT
The class meets once per week, 3 hours per day.

SPECIAL ACCOMMODATIONS
If you require any special accommodations or have any special learning needs, please inform the instructor and submit a request using CEA's ***Special Accommodations Form*** to the onsite CEA academic staff by the end of the first week of classes for full consideration. See Section III.B.CEA Policies below for additional details.

FORMS OF ASSESSMENT
The instructor will use numerous and differentiated forms of assessment to calculate the final grade you receive for this course. For the record, these are listed and weighted below. The content, criteria and specific requirements for each assessment category will be explained in greater detail in class. Any questions about the requirements should be discussed directly with your faculty well in advance of the due date for each assignment.

FORM OF ASSESSMENT	VALUE
Class Participation	10%
Homework Assignments	20%
Quizzes	20%
Mid Term exam	25%
Final exam	25%

When deciding class participation grades, traditional criteria such as attendance, punctuality, preparation, completed reading before class, interactive group work and active, meaningful participation are all taken into account. The following guidelines may help you organize your time and class work:

Class Participation (10%): This grade will be calculated to reflect your participation in class discussions, your capacity to introduce ideas and thoughts dealing with the texts, your ability use language effectively, and to present your analysis in intellectual, constructive argumentation.

When determining your class participation grade, traditional criteria such as material preparation, completed reading before class, and collaborative group work are all evaluated. But it is the active, meaningful and informed verbal and written contribution that you make that is most important to your overall participation grade. Indeed, willingness to share views in classroom discussions and the insightfulness of your comments and questions about assigned readings will all be taken into account when evaluating your participation.

Additionally, it is important to demonstrate a positive and supportive attitude to the instructor and your classmates, and give full attention to class activities (i.e., cell-phones off, laptop for notes only, not sleeping or distracted, etc.). Whereas attendance and punctuality are expected and will not count positively towards the grade, laxity in these areas will have a negative effect. The instructor will use the following specific criteria when calculating your class participation grade:

Criteria for Assessing Class Participation	Grade
You make major and original contributions that spark discussion, offering both critical and analytical comments clearly based on readings and research and displaying a working knowledge of theoretical issues.	A+ (9.70–10.00)
You make significant contributions that demonstrate insight as well as knowledge of required readings and independent research.	A-/A (9.00–9.69)
You participate voluntarily and make useful contributions that are usually based upon some reflection and familiarity with required readings.	B/B+ (8.40–8.99)
You make voluntary but infrequent comments that generally reiterate the basic points of the required readings.	C+/B- (7.70–8.39)
You make limited comments only when prompted and do not initiate debate or show a clear awareness of the importance of the readings.	C-/C (7.00–7.69)
You very rarely make comments and resist engagement with the subject, attending class having manifestly done little if any preparation.	D (6.00–6.99)
You make irrelevant and tangential comments disruptive to class discussion, a result of frequent absence and complete un-preparedness.	F (0–5.99)

Homework Assignments (20%): You will be assigned homework on a weekly basis. Homework will involve solving problems on specific topics covered in the course and building the skills needed for the midterm and final exams.

Quizzes (20%): There are four 30-minute, in-class quizzes that serve to evaluate your understanding of key concepts and skills that form the basis for the learning objectives of the course.

Midterm Exam (25%): The midterm exam is a 1 hour and 30 minute test that evaluates your understanding of the concepts of fundamental kinematics and kinetics. It will involve the kinetic analysis of point particles.

Final Exam (25%): The final exam is a 1 hour and 30 minute test with problems involving rigid bodies

CEA Grading Scale				
Letter Grade	**Numerical Grade Low Range**	**Numerical Grade High Range**	**Percentage Range**	**Quality Points**
A+	9.70	10.00	97.0 - 100%	4.00
A	9.40	9.69	94.0 - 96.9%	4.00
A-	9.00	9.39	90.0 – 93.9%	3.70
B+	8.70	8.99	87.0 – 89.9%	3.30
B	8.40	8.69	84.0 – 86.9%	3.00
B-	8.00	8.39	80.0 – 83.9%	2.70

C+	7.70	7.99	77.0 – 79.9%	2.30
C	7.40	7.69	74.0 – 76.9%	2.00
C-	7.00	7.39	70.0- 73.9%	1.70
D	6.00	6.99	60.0 – 69.9%	1.00
F	0.00	5.99	0 - 59.9%	0.00
W	Withdrawal			0.00
INC	Incomplete			0.00

CEA ATTENDANCE POLICY

Every student is expected to attend all scheduled class sessions (including field studies), arriving on time and thoroughly prepared for the day's class activities. In compliance with NEASC and UNH accreditation requirements, CEA instructors compile regular attendance records for every course and take these records into account when evaluating student participation and overall course performance.

In this course, students are allowed to have the following number of absences due to sickness, personal emergency, inevitable transport delay and other related impediments:

Courses that meet X days per week	**Allowed absences**	**Automatic failing grade at 4th absence**
SEMESTER		
Courses that meet **1** day per week	1	4

No documentation is required for such absences, as CEA does not distinguish between excused or unexcused absences. For every additional absence beyond the allowed number, the final course grade will drop down to the subsequent letter grade (e.g., A+ to A).

The following table below outlines how your absence(s) will impact your overall grade:

Absence	**1**	**2**	**3**	**4**
Penalty	No Penalty	1/2 letter grade	One full letter grade	Automatic Failure
Grade	A+	A	A-	F

Late arrivals or early departures from class (30 min away from class) will result in being marked absent. Furthermore, to comply with UNH, CEA and in country immigration regulations, you must maintain full-time student status by enrolling and regularly attending at least 12 credit hours per week for the duration of the semester. Consequently, CEA will dismiss from all CEA courses, programs, activities and housing any student who fails to maintain satisfactory academic progress or full-time student status.

WORKLOAD EXPECTATIONS

In conformity with CEA policy, all students are expected to spend at least two hours of time on academic studies outside of, and in addition to, each hour of class time.

REQUIRED READINGS

Listed below are the required course textbooks and additional readings. Whether you buy your books from our locally affiliated merchants or whether you acquire these before arrival, you must have constant access to these resources for reading, highlighting and marginal note-taking. It is required that you have unrestricted access to each. Additional copies will be placed on reserve in the Academic Affairs office for short-term loans. Access to additional sources required for certain class sessions will be provided in paper or electronic format consistent with applicable copyright legislation. In addition, the Academic Affairs Office compiles a bank of detailed information about the many libraries, documentation centers, research institutes and archival materials located in the host city and accessible to CEA students. You will be required to use these resources throughout your studies. Direct access to additional resources and databanks are available to you through the online library of the University of New Haven. Please find the required reading(s) and/or text(s) for this course below:

Hibbeler, R. C. *Engineering Mechanics: Dynamics* (14th Edition). Pearson, Hoboken, 2016, 760pp.

RECOMMENDED READINGS

Please find the recommended reading(s) and/or text(s) for this course below:

Meriam J.L., Kraige, L.G., *Engineering Mechanics – Dynamics (7th Edition)*. Wiley & Sons, 2012, 750pp.

Kittel, C., Knight, W. D., Ruderman, M. A. *Berkeley Physics Course : Mechanics (2nd Edition)*. McGraw-Hill, New York, 1973, 426pp.

Feynman, R., and Leighton, R. *The Feynman Lectures on Physics, Vol. I: The New Millenium Edition.* Basic Books, New York, 2011, 560pp.

ADDITIONAL RESOURCES

UNH Online Library: As part of this program, you are provided with direct access to additional resources and databases available through the online library of the University of New Haven. To access the online UNH library, go to http://www.newhaven.edu/library/Services/CEA/ **.**

Students at CEA Study Abroad Centers have access to the several online research databases through the University of New Haven Library for the purposes of research. Access to these online databases is granted only during the time of enrollment, requires the use of a UNH ID number, which is issued individually to all Study Abroad Center students at the start of the semester. Access to the UNH Library is available through the *MyCEA Account*. You must comply with UNH policies with regard to library usage. Policies can be found at: http://www.newhaven.edu/library/general/Policies/

CEAClassroom – CEA's Moodle CMS: CEA instructors use the open source course management system (CMS) called Moodle that creates an interactive virtual learning environment for students and educators alike. This web-based platform provides you with 24/7 access to the course syllabus, daily schedule of class lectures and assignments, non-textbook required readings, and additional resources directly related to your studies. Moodle includes the normal array of forums, up-loadable and downloadable databases, wikis, and related academic support designed for helping you achieve the many course learning objectives. The ceaClassroom website is located here: https://www.ceaClassroom.com/

During the first week of class, the CEA academic staff and instructors will provide you with log-in information and corresponding passwords to access this site. They will also help you navigate through the many functions and resources Moodle provides. While you may print a hard copy version of the syllabus that is projected on the first day of class, it is the class schedule on Moodle that is the definitive and official one, given that the

instructor will be announcing updates and additions there and nowhere else. It is your responsibility to ensure that you have access to all Moodle materials related to your course and that you monitor Moodle on a daily basis so as to be fully informed of required course assignments and any scheduling changes that might occur.

Course Calendar: *Dynamics with Vibrations Module*			
Session	**Topic**	**Activity**	**Student Assignments**
1	**Introduction to course, review of syllabus and classroom policies** **Introductory concepts: kinematics**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 12: 12.1-12.3
	Curvilinear motion and motion of a projectile	Discussion in class	**Reading (textbook, to be done before session):** Chapter 12: 12.4-12.6
2	**Curvilinear motion: Normal and tangential components**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 12: 12.7
	Curvilinear motion: polar and cylindrical components, relative motion	Discussion in class	**Reading (textbook, to be done before session):** Chapter 12: 12.8, selections of 12.9 and 12.10 **First assignment (to be done after session):** Point particle kinematics (see Moodle for details)
3	**Point particle dynamics I** **First quiz (planar motion)**	Discussion in class - First quiz	**Reading (textbook, to be done before session):** Chapter 13: 13.1-13.4
	Point particle dynamics II	Discussion in class	**Reading (textbook, to be done before session):** Chapter 13: 13.5
4	**Work and energy I**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 14: 14.1-14.4

	Energy conservation	Discussion in class	**Reading (textbook, to be done before session):** Chapter 14: 14.5-14.6
5	**Impulse and momentum** **<u>Second quiz (Point particle dynamics)</u>**	Discussion in class - Second quiz	**Reading (textbook, to be done before session):** Chapter 15 : 15.1-15.3
	Impact and collisions	Discussion in class	**Reading (textbook, to be done before session):** Chapter 15: 15.4 **<u>Second assignment (to be done after session):</u>** Energy conservation (see Moodle for details)
6	**Angular momentum and moment of a force**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 15: 15.5-15.6
	Principle of angular impulse and momentum	Discussion in class	**Reading (textbook, to be done before session):** Chapter 15: 15.7
7	**MIDTERM EXAM** **(Kinematics, point particle dynamics, energy, collisions)**		
8	**Rigid body kinematics**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 16: 16.1-16.4
	Rigid body kinematics: relative motion I	Discussion in class	**Reading (textbook, to be done before session):** Chapter 16: 16.5

9	**Rigid body kinematics: relative motion II**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 16: 16.6
	Rigid body kinematics: relative motion III	Discussion in class	**Reading (textbook, to be done before session):** Chapter 16: 16.7
10	**Rigid body kinematics: relative motion IV**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 16: 16.8
	Rigid body dynamics	Discussion in class	**Reading (textbook, to be done before session):** Chapter 17: 17.1-17.3 **<u>Third assignment (to be done after session):</u>** Rigid body kinematics (see Moodle for details)
Vibration Module 1	**Undamped free vibrations** **Viscous damped free vibrations** **(particles & rigid bodies)**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 22: 22.1, 22.4
11	**Rigid body dynamics: Rotation about a fixed axis** **<u>Third quiz (Rigid body kinematics)</u>**	Discussion in class - Third quiz	**Reading (textbook, to be done before session):** Chapter 17: 17.4
	Rigid body dynamics: planar motion	Discussion in class	**Reading (textbook, to be done before session):** Chapter 17: 17.5
Vibration Module 2	**Undamped forced vibrations** **Viscous damped forced vibrations** **(particles & rigid bodies)**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 22: 22.3, 22.5
12	**Rigid body dynamics: energy**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 18: 18.1-18.4

	Rigid body dynamics: conservation of energy	Discussion in class	**Reading (textbook, to be done before session):** Chapter 18 : 18.5 **<u>Fourth assignment (to be done after session):</u>** Open-ended discussion of an engineering application (see Moodle for details)
Vibration Module 3	**Viscous damped force vibration** **Energy methods**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 22: 22.2
13	**Rigid body dynamics: impulse and momentum** **<u>Fourth quiz (rigid body dynamics)</u>**	Discussion in class - Fourth quiz	**Reading (textbook, to be done before session):** Chapter 19: 19.1-19.3 (selected topics)
	Gyroscopic motion	Discussion in class	**Reading (textbook, to be done before session):** Chapter 20-21: selected topics
Vibration Module 4	**Electrical circuits analogy** **Introduction to non-linear vibrations** **Vibrations module review**	Discussion in class	**Reading (textbook, to be done before session):** Chapter 22: 22.6
14	**FINAL EXAM (cumulative)**		

SECTION III: CEA Academic Policies

The policies listed in this section outline general expectations for CEA students. You should carefully review these policies to ensure success in your courses and during your time abroad. Furthermore, as a participant in the CEA program, you are expected to review and understand all CEA Student Policies, including the academic policies outlined on our website. CEA reserves the right to change, update, revise, or amend existing policies and/or procedures at any time. For the most up to date policies, please review the policies on our website.

Class & Instructor Policies can be found here

General Academic Policies can be found here