FLORIDA INTERNATIONAL UNIVERSITY
Mechanical Engineering Department

Fall 2020 System Dynamics EML3222

Instructor: Professor Cesar Levy (levyez@fiu.edu)
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Office hours: **will be announced during the first week. They will occur through ZOOM.**

TA: At this time there is no TA assigned to the class. Please contact me via email regarding any questions you might have or participate in the closest ZOOM office hour session to have your question answered.

COURSE OBJECTIVES
Understand Undamped SDOF systems $d^2x/dt^2+\omega^2x=0$ and its relation to a vibrating system
Understand Damped SDOF systems-viscous (underdamped, critically damped and overdamped) and coulomb friction and their differences
Understand Forced Motion due to external input
Understand the essentials of modeling Understand the lumped parameter concept Understand the similarities and differences between: a) linear mechanical systems b) rotational mechanical systems c) fluid systems d) electrical systems e) thermal systems Understand transformers and transducers Understand system graphs Understand how to get the equations of motion Understand how to solve the equations of motion using: closed form, numerical methods, transform methods, state variable-matrix methods

MME Student Outcomes	
Relationship of the course to student outcomes:	
1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics	(✓)
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental and economic factors	()
3. An ability to communicate effectively with a range of audiences	(✓)
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts	( )
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives	( )

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	()
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	(✓)

PREREQUISITES: EGN3321, EMA3702, EML2032 with a grade of C or better. Students not having the required passing grade in the prerequisite courses should drop EML3222 during the drop/add period. Violators will be dropped out automatically later on during the semester. This may result in their loss of course tuition. **You must also be registered for 3 credits not 2**.

COURSE CONTENT

Topics

1. What is vibrations and its importance
2. Equivalent Systems and Equations of Motion
3. Free Vibrations of M-K system, Energy Methods
4. SDOF with damping E1
5. Forced SDOF without damping
6. Forced SDOF with damping
7. Other Systems-Fluidic, thermal E2
8. Understand the essentials of modeling, lumped parameter concept
9. Understand the similarities and differences between:
   a) linear mechanical systems
   b) rotational mechanical systems
   c) fluid systems
   d) electrical systems
   e) thermal systems
10. Understand transformers and transducers
11. Understand system graphs
12. Understand how to get the state variable equations E3
13. Understand how to solve the state variable equations using some of the following:
    closed form, numerical methods, possibly state variable-matrix methods

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1. Importance of Vibrations; Basic Concepts--period, amplitude, circular frequency, units; Classification of Vibrations-- random, periodic, harmonic, aperiodic; Vibrational Analysis Procedures; Quick Review of Dynamics--Kinetics and Principle of Linear and Angular Motion of a Particle, Mass Center and a System of Particles.

2. Undamped Free Vibrations for a Single Degree of Freedom (SDOF) System: Spring-Mass System; Equivalent Springs and Masses; Energy Method--KE<->PE transfer.

3. Damped Free Vibrations for an SDOF System; Spring-Mass-Dashpot System; Overdamped, Underdamped, Critically Damped System, damped frequency, damping factor, general solutions, Quick Review of second order linear constant coeff. Diff. Eqs.; Coulomb Damping, frequency displacement decrease, differences between coulomb and viscous damping.

4. Forced Vibrations (FV) of an SDOF System; Undamped and Damped Vibrations--magnification factor, resonance conditions; beats; force transmission; Duhamel's Integral; Response of a Damped System.

5. Essentials of Modelling--Capturing the gist of the real-life system
   - o Modelling of mechanical systems by
     springs, masses, dampers, v - F relationships
   - o Modelling of electrical systems by

inductance, capacitance, resistances, v - i relationships
- o Modelling of fluidic systems by
  inertance, capacitance, resistances, p - Q relationships
- o Modelling of thermal systems by
  capacitance, resistances, T - q relationships

6. Thru and Across Variables; systems equations; system graphs
7. Determination of governing equation for the system
8. Solution of the governing differential equation --
   - o State Variables and Matrix Methods of Solution
   - o Numerical Methods (Euler and Runge-Kutta Methods)

If time is available

- o Closed form solutions (reduction of order and variation of parameter methods)
- o Laplace Transform Method

Textbook: Introduction to System Dynamics by Derek Rowell and David Wormley, Prentice-Hall, 1st Edition ISBN 978-0132108089, 1996

*** ANY OTHER NOTES NEEDED WILL BE DISTRIBUTED VIA THE WEBSITE AND CANVAS ***

Other helpful information

HW's that are assigned and announced for collection will be collected for grading. Website and the canvas site will provide solutions to many problems two lessons after they are assigned. However, it is to your advantage to do the problems since similar problems will appear on the exams and final exam.

Important information:

You are required to send me an email using an email address from which you can receive class information.

Since the University has decided to convert large Face-2-Face classes to remote learning, several things will be happening.

1. **Our class is being converted to a remote synchronous course, meaning we will meet via ZOOM. You will be informed ahead of time of the ZOOM meetings during which this class is to meet, namely, 2 times a week T and R (Thursday) 1100-1215.**
2. **You will be required to turn on your cameras when you attend the ZOOM class. When you initially log into ZOOM you will be placed in a meeting room. Once in the meeting room, you will be admitted by me at the first chance available.**
3. **No attendance will be taken. HOWEVER, if you do not attend the ZOOM class for whatever reason, it is your responsibility to get the material you've missed and to learn the material (check the videos).**
4. **Exams will be announced 7-10 days before the exam date. No make up quizzes/exams will be given**. Exceptions are if you are sick (provide a note from your doctor), or if you are being called up for military duty (provide a copy of your orders).
5. **If you don't understand something in class-ASK whether during class or during the ZOOM office hours**.

Important technological items to keep in mind since this class is being given remotely but synchronously:

1) We will be meeting remotely but synchronously 2 times a week T and R (Thursday) 1100-1215 via ZOOM. You will be notified of all ZOOM office hours and ZOOM class meetings at least two days ahead of time.

2) Make sure your equipment (smartphone, computer, etc.) is prepared for the ZOOM class meetings ahead of time.

2) The website on which materials related to this class will be provided is http://web.eng.fiu.edu/levy and on CANVAS. Videotapes related to this class will be available both on the website and on the CANVAS (check for the EML3222 1208 course) in case you cannot attend a class. It is, however, in your best interest to attend the ZOOM classes if required.

3) **All exams will be given through Canvas using Honorlock**. Please go to the canvas website and review **the Honorlock student requirements at least a week before the exam and work out any problems with the Honorlock/Canvas support personnel.**

4) Any HW assigned for grading will be submitted electronically by you, graded, and returned electronically to you.

5) Grading will NOT be updated on Canvas; however, grading will follow the grading scheme given in the syllabus. Grading, if modified, will be announced.

6) Communications will be through regular email, canvas email or through the Canvas discussion section (for the entire class).

7) Office hours will be handled through ZOOM and any class meetings will be handled through ZOOM.

8) ZOOM class meetings and class exams will occur during class meeting times.

9) ZOOM class meeting videos will also be uploaded to Canvas and the website when necessary within 4 hours.

10) Since remote learning will be the norm for the class, it behooves you to attend all ZOOM class meetings and keep up with the class work. DO NOT COUNT ON USING THE RECORDED LECTURES ONLY, BECAUSE, SINCE THE TIME OF THE RECORDINGS, THE LECTURES HAVE BEEN ENHANCED WITH ADDED EXAMPLES NOT ON TAPE.

Grading

Grades will be determined on the basis of

3 Exams	20, 25, 25% each
Final exam	30%

Grading Scheme: 93 and above	A	80 - 84	B	67 - 73	C
90 - 92	A-	77 - 79	B-	60 - 66	D
84 - 89	B+	74 - 76	C+	Below 60	F

Office hours: **will be through ZOOM and will be announced every week.**

TA: We have no TA assigned to this class. If you have questions, please see me during ZOOM office hours or email me with your questions. I try to answer your questions within two hours.

Other important information

Cheating of any kind especially during quizzes/examinations will result in automatic failure of the exam/quiz. Cheating during final exam will result in failure of the course and possible expulsion from the university.

Please note: *Florida International University is a community of faculty, staff and students dedicated to generating and imparting knowledge through 1) excellent teaching and research, 2) the rigorous and respectful exchange of ideas, and 3) community service. All students should respect the right of others to have an equitable opportunity to learn and honestly demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.*

The Drug-Free Schools and Communities Act Amendments of 1989 and the Drug-Free Workplace Act of 1988 (collectively the "Act"), require that Florida International University (FIU) maintain a program to prevent the use of illicit drugs and abuse of alcohol by students, faculty, and staff. Under the Act, FIU is also required to annually distribute the following information about its drug and alcohol program to all students, faculty, and staff. Please read this notification carefully. Click here for a more detailed version of this notification.

POLICY: The university is committed to maintaining a safe, productive, and drug-free work and educational environment. As such, FIU strictly prohibits the unlawful manufacture, distribution, dispensation, possession, trade, sell, or offer for sale of a controlled substance or alcohol, or otherwise engaging in the unlawful use of controlled substances or alcohol on campus. No person may report to classes, work, or related assignments "under the influence" of controlled substances, alcohol, or prescription drugs taken illegally. Furthermore, all employees are required to notify the university of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction. Click here to read the complete Drug-Free Campus/Workplace Drug and Alcohol Abuse Prevention Policy, which can be found in the University Policies and Procedures Library.

SANCTIONS: Any student, faculty or staff found to have abused drugs and/or alcohol in the workplace or campus shall be subject to disciplinary action in accordance with university regulations, policies and any applicable collective bargaining agreement.

DRUGS: The unlawful possession, use, distribution, dispensation, manufacture, or sale of Controlled Substances is governed by federal law, Florida law, university regulation (FIU-2501 Student Code of Conduct), and university policy.

ALCOHOL: The use, possession, or distribution of beverages containing alcohol on university property, including residence halls, is governed by Florida law and university regulations (FIU-2505 Alcoholic Beverages, FIU-2501 Student Code of Conduct).

HEALTH RISKS: Drugs have different effects on each individual, depending on their age, size and sex. The manner in which a particular drug interacts with a person can cause temporary or permanent damage to a person's body and brain, and can lead to addiction or death. Description of drugs and effects can be found in the DEA Drug Fact Sheets.

Alcohol is a depressant which leads to the loss of control over judgment, resulting in a loss of inhibitions. It affects physical coordination, causing blurred vision, slurred speech and loss of balance. Click here for a summary of health problems and conditions associated with excessive drinking over time.

RESOURCES: Click here for a list of on-campus and community resources for drug and alcohol prevention and assistance.

For additional information, please contact Dr. Kate Kominars, Director of the Office of Employee Assistance and Chair of the Alcohol and Drug Abuse Prevention Task Force, at 305-348-2469 or kominars@fiu.edu.

THIS IS A PRELIMINARY SCHEDULE--ALL CHANGES WILL BE ANNOUNCED IN CLASS, or ZOOM, and on Class website.