



MATH245: Mathematics of Physics & Engineering I

Units: 4

Fall 2019

MWF: @ 11:00 - 11:50 am in THH 116 (class # 39598)

MWF: @ 12:00 - 12:50 pm in THH 116 (class # 39602)

Instructor: Ramtin Sheikhhassani

Office: RRB217

Office Hours: MW 2:00-5:00 PM

or by appointment

Contact Info: sheikhha@usc.edu – Include MATH245 in subject
I will respond to all emails within 48 hours

Teaching assistants:

Ms. Anahid Khoobyar

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Mr. Amin Naghdloo

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Grader:

TBD

Please note that the syllabus is subject to change based on the needs of the class. Changes, if any, will be announced in class. Students will be held responsible for all changes.

Course Description

This course introduces mathematical models that govern the laws of universe. These laws are formulated in terms of differential equations. Differential equations involve functions and their derivatives which are often with respect to time. Engineers and scientists should understand, construct, solve and interpret differential equations using contemporary analytical and numerical methods.

Learning Objectives and Outcomes

- Understand the concept of differential equations and their classification
- Develop, select and apply solutions for 1st order, 2nd order and higher order homogenous and non-homogenous equations by manual and numerical-based methods
- Apply Laplace transforms to solve ordinary linear differential equations (ODEs)
- Find solutions to systems of differential equations using eigenvalues, matrix of exponents and diagonalization
- Solving and approximating non-linear ODEs using analytical and numerical methods
- Demonstrate proficiency in using MATLAB to solve, analyze and interpret ordinary differential equations.

Prerequisite: Calculus III Math 226 or 227

Required Readings

Differential Equations: An Introduction to Modern Methods and Applications. 3rd Edition
James R. Brannan, William E. Boyce, ISBN: 978-1-118-53177-8, Jul 2015 Wiley

Course Notes

Copies of lectures notes, and other class information will be posted on Piazza.

Communication

I want you to feel comfortable asking questions and giving me feedback on the course. If you have questions or comments, please speak to me directly after class or during my posted office hours. You can also email me (sheikhha@usc.edu). I will respond to all emails within 48 hours.

Technological Proficiency and Hardware/Software Required

This course requires use of Blackboard, Piazza, and MATLAB. An introduction regarding installation, activation and basic operations will be provided during the first two weeks of class.

Description and Assessment of Assignments

- 1- Homework: at least 12 HW will be assigned. Problems will be posted on blackboard. Two of the lowest homework grades will be dropped. NO late homework will be accepted.
- 2- MATLAB simulation assignments will be assigned on a weekly basis.
- 3- Quizzes: weekly quizzes conducted in the discussion sessions on Thursdays, with problems extracted from assigned homework or similar problems. and NO “make-up” of any of the quizzes will be offered. Two of the lowest quiz grades will be dropped before a final course grade is calculated.
- 4- Exams:
 - a. Tentative Midterm exam dates:
 - i. **Midterm 1:** Monday, September 30, class time
 - ii. **Midterm 2:** Monday, November 4, class time

b. Final Exam:

the final exam is comprehensive and will be held at the time specified in the University Schedule of Classes:

Wed. Dec. 11 , 11am-1pm (class # 39598)
Fri. Dec. 13. , 11am-1pm (class # 39602)

A respectable performance on quizzes and exams can be realized by all students if attention and energy are given to the timely completion of assigned homework problems.

Grading Breakdown

Assignment	% of Grade
HW	5
Simulations	10
Quizzes	20
Midterm#1	20
Midterm#2	20
Final	25
TOTAL	100

Grading Scale

Course final grades will be determined using the following scale

A	93-100
A-	90- 92
B+	88-89
B	83-87
B-	80-82
C+	78-79
C	73-77
C-	70-71
D+	68-69
D	63-67
D-	60-62
F	59 and below

Assignment Submission Policy

No late homework will be accepted. Two of the lowest grades in homework and quizzes will be dropped.

Additional Policies**Attendance**

Some topics in class will be handled differently from the book. You will be responsible for the way things are done in class. Class attendance is strongly encouraged.

Technology in the classroom

Cellphones, laptops, tablets (except for note-taking purposes) and anything else electronic are to be turned off during class.

Final grade will depend entirely on the performance on the above components and be independent of the financial support requirements (e.g., minimum grade requirement for tuition reimbursement).

Please schedule your work-related travel during time periods outside of the mid-term and final exams. Accommodation to take exams on different dates will be made only for family emergencies, religious observance and documented illness or health-related emergencies.

Course evaluation

Two surveys will gather student opinions about the course: the mid-semester evaluation and the standard USC course evaluation survey at the end of the semester. Your opinion is valued and can make a difference in how this course is conducted; please give your honest and constructive recommendations.

Course Schedule: A Tentative Weekly Breakdown subjected to adjustments

Lec	Date	Principle Topics	Reading	Homework
1	Mon Aug 26	Intro, Classification, Separable 1 st order, dir-field	1.1-3	
2	Wed Aug 28	Linear 1 st order, constant coefficient ODE	2.2	
3	Fri Aug 30	Linear 1 st order, variable coefficient ODE: Integral factor	2.4	
4	Wed Sep 4	Bernoulli's equations. Stability/Instability		HW1
5	Fri Sep 6	2 nd Order: Characteristic and Fundamental solutions	4.1-2	
6	Mon Sep 9	2 nd Order homogenous ODE: Real roots, Abel's theorem	4.2	
7	Wed. Sep 11	Characteristic repeated roots	4.3	HW2
8	Fri. Sep 13	Characteristic complex roots	4.3	
9	Mon Sep 16	Application: vibration	4.4	
10	Wed Sep 18	Amplitude-phase form, Free damped motion	4.4	HW3
11	Fri. Sep 20	2 nd Order nonhomogeneous: Undetermined coefficients	4.5	
12	Mon. Sep 23	2 nd Order nonhomogeneous: Undetermined coefficients	4.5	
13	Wed. Sep 25	Applications: Electrical circuits. Resonance	4.6	
14	Fri. Sep 27	Higher order ODE		HW4
	Mon Sep 30	Midterm #1		
15	Wed. Oct 2	Variation of Parameters	4.7	HW5
16	Fri. Oct 4	Intro to Laplace transforms	5.1	
17	Mon. Oct 7	Properties of Laplace	5.2	
18	Wed. Oct 9	Properties of Laplace	5.2	HW6
19	Fri. Oct 11	Inverse Laplace	5.3	
20	Mon Oct 14	ODEs with Laplace	5.4	
21	Wed. Oct 16	Unit step function	5.5	HW7
22	Fri. Oct 18	ODE with unit step	5.6	
23	Mon Oct 21	Laplace of Periodic functions	5.5	
24	Wed. Oct 23	Delta Dirac function	5.7	HW8
25	Fri. Oct 25	Impulse response	5.7	
26	Mon.Oct 28	Convolution	5.8	
27	Wed. Oct 30	Linear systems and feed-back control	5.9	HW9
28	Fri. Nov 1	Review of Laplace		
	Mon. Nov 4	Midterm #2		
29	Wed. Nov 6	Intro to system of ODE		
30	Fri, Nov 8	Review of matrices, vectors and linear systems	3.1 and App A	
31	Mon.Nov 11	Eigenvalues and eigenvectors	3.1	
32	Wed. Nov 13	System of ODEs	3.2	HW10
33	Fri. Nov 15	System of ODEs	3.3	
34	Mon.Nov 18	System of ODEs: complex eigen values	3.4	
35	Wed. Nov 20	System of ODEs: repeated eigen values	3.5	HW11
36	Fri.Nov 22	Non-homogenous system of ODE , Exponential of a matrix	3.6,6.5,6.6	
37	Mon.Nov 25	Intro to non-linear system of ODEs and fixed points	7.1, 7.2	
38	Mon.Dec 2	Exact Equations	2.1,2.6	
39	Wed,Dec 4	Exact Equations	2.6	
40	Fri. Dec 6	Review		HW12

Discussion MATLAB schedule:

- Introduction to MATLAB and Plotting
- Introduction to Runge-Kutta Method
- Use ODE45 to solve 1st order ODEs
- Plotting direction fields
- Apply ODE45 for parametric ODEs
- ODE45 and 2nd order ODEs
- Phase plots
- Nonlinear ODEs
- Higher Order ODEs and ODE45
- Laplace transforms and Inverses with MATLAB
- Transfer function and stability
- Eigenvalues, Eigenvectors and system of ODEs
- Predator and Prey

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call

engemannshc.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call

engemannshc.usc.edu/rsvp

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) | Title IX - (213) 740-5086

equity.usc.edu, titleix.usc.edu

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421

studentaffairs.usc.edu/bias-assessment-response-support

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

studentaffairs.usc.edu/sssa

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.