

# PRINCIPLES OF ENGINEERING ANALYSIS- I

*Academic Term: Fall 2021*

**Instructor: Dr. Oana Cazacu, Professor, Dept. Mechanical and Aerospace Engineering**

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## **Class Schedule:**

**Lectures are taught and professionally video recorded in the REEF studio in Shalimar, FL on Tuesday: 11:00 am-1:00 pm and 2:00-3:00 pm EST.**

As has been done for at least the past 3 years, the videos will be posted shortly after recording on Canvas, so students in each section can view them at any time, depending on their schedule.

**Gainesville:** The video recordings of classes taught from Shalimar are scheduled to be shown on Tuesday:

7th Period Thursday: 7th and 8th Periods; CSE E122

For Fall 2021, there is no requirement for the students to view the lectures in CSE E122.

## **Course Description for EGM 6321- 3 credit hours**

Solution of linear and nonlinear ordinary differential equations. Methods of Frobenius, classification of singularities. Integral representation of solutions. Treatment of the Bessel, Hermite, Legendre, hypergeometric, and Mathieu equations. Asymptotic methods including the WBK and saddle point techniques. Treatment of nonlinear autonomous equations. Phase plane trajectories and limit cycles. Thomas-Fermi, Emden, and van der Pol equations.

## **Course Pre-Requisites / Co-Requisites**

Completion of elementary calculus and undergraduate ordinary differential equations course such as EGM 4311 or MAP 4305 or permission of the instructor

## **Course Objectives**

The goal of EGM 6321 is to provide the students with the ability to find the proper mathematical setup for given physical and engineering problems and methodologies to find closed-form solutions.

## **Required Textbooks and Software**

No required text. Course notes are developed by the instructor

## **Recommended Materials**

1. Differential Equations by Shepley L. Ross, ISBN 0-471-0329-8
2. Special Functions & Their Applications by N.N. Lebedev, ISBN 0-48660624-4
3. Differential Equations: Linear, Non-linear, Ordinary, Partial by A.C. King, J. Billingham and S.R. Otto, Cambridge University Press, ISBN:0521 01687 8

## **Lecture Topics**

### **First-order linear differential equations**

Bernoulli and Riccati Eqs; Applications of 1<sup>st</sup> order ODEs

### **Second-order linear ODEs with constant coefficients**

#### **I.1. Series solutions of 2<sup>nd</sup> order ODE with constant coefficients**

##### **I.1. Solution by Power series about regular points**

Airy and Hermite Equations; Properties of Airy functions and Hermite polynomials

##### **I.2: Solutions about singular points**

Bessel Equations and Functions: series solutions of Bessel Equations; Differential and recurrence relations between Bessel functions; Hyperbolic Bessel equations and applications; Generalized Bessel equations; Physical applications of Bessel functions

Hypergeometric equations; Legendre Equation, Legendre polynomials; Rodrigues formula; Physical applications of Legendre Polynomials

Chebyshev equation; Properties of Chebyshev polynomials

#### **II. Integral representation of the solutions of 2<sup>nd</sup> order ODEs with constant coefficients**

Laplace kernel; Euler kernel; Integral representation of Bessel functions; Integral representation of the solutions of Hermite equation; Integral representation of Laguerre polynomials;

#### **III. Asymptotic Methods for Differential Equations**

Asymptotic evaluation of Integrals: Laplace method; The method of stationary phase; The method of steepest descent

Regular perturbations

The Method of Matched Asymptotic Expansions; Van Dyke's Matching Principle

Elliptic Integrals

#### **IV: Non-linear ODEs:**

First order Autonomous Nonlinear Ordinary Differential Equations

Second-Order Autonomous Nonlinear Ordinary Differential Equations

Stability, Instability and Bifurcations

**Policies and Procedures: Homework:** Problems will be assigned on Tuesday and collected at the beginning of the following Tuesday class meeting. Late homework will not be accepted. However, since difficult weeks will arise during the semester, each student will be permitted one late homework assignment turned in not more than one week after the original due date. Hardship cases will be considered on an individual basis and only if the instructor has been contacted *before* the due date of the assignment.

**Exams:** Two 2- hours exams will be given during the semester during the regularly scheduled class time. No "final exam" will be given. All the exams are open-notes, but closed book, closed- homework solutions. No exams will be given prior to the scheduled dates and no makeup exams will be allowed. Exam 1 is scheduled on 10/14; Exam 2 is on 11/18, for 7th and 8th Periods.

### **Attendance Policy, Class Expectations, and Make-Up Policy**

In person attendance is not required. You are personally responsible for all information disseminated during the lectures. This means knowing all homework due dates, knowing when exams will be given, where they will be given, what material they will cover, and knowing all material, handouts, and announcements made in the lectures, whether or not you were present. Thus, if you miss a lecture, it is your responsibility to obtain all information presented during that lecture. "I missed that information" or "I was unaware of that information" will not be accepted as valid excuses.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

**Course web site.** A course web site is established through EDGE. Students will be expected to check it on a regular basis for up-to-date course information. This may include changes to the syllabus, homework assignment due dates, and exam schedules.

**Grading:** Grades will be determined using these weights: 20% Homework, 45% Exam 1, 35% Exam 2.

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

For individuals in the gray area between two grades, performance on the homework will be used to make the final decision

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

### **Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### **In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor

hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session. Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Malisa SARNTINORANONT, GRADUATE STUDENT COORDINATOR, (352) 392-8404, [msarnt@ufl.edu](mailto:msarnt@ufl.edu)
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

***Campus Resources:***  
***Health and Wellness***

**U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

**Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

## Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.