DIFFERENTIAL EQUATIONS – MAP 2302

COURSE SYLLABUS

FALL 2016 – CRN 16783 – TR 1:00PM to 2:15PM

INSTRUCTOR: John C. Niss

OFFICE: 248 Valencia Winter Park Campus

OFFICE HOURS: M 9:00am to 10:00am, 12:00pm to 3:00pm

TR 9:00am to 10:00am

W 9:00am to 10:00am, 11:30am to1:30pm

F 10:30am to 11:30pm VIRTUAL

PHONE/E-MAIL: 407-582-6858 / [jniss@valenciacollege.edu](mailto:jniss@valenciacollege.edu) DO NOT USE BLACKBOARD EMAIL

CREDIT HOURS: 3

PREREQUISITE: Minimum grade of C in MAC2313 or department approval

TEXT: Bronson and Costa, Schaum’s Outlines, Differential Equations, 4th Edition

Graphing Calculator

CONTENT: Exam 1 1, 2, 3, 4, 6, 7, 18

Exam 2 9, 10, 11, 13, 14

Exam 3 21, 22, 23, 24

After Exam 3 Misc topics

COURSE DESCRIPTION:

Introduction to methods and applications of ordinary differential equations. Topics include first order differential equations and applications; higher order linear differential equations with applications; Laplace transforms; introduction to numerical methods

COURSE COMPETENCIES:

Valencia faculty have defined four interrelated competencies (Value, Think, Communicate, Act) that prepare students to succeed in the world community. These competencies are outlined in the College Catalog. In this course, through classroom lecture and discussion, group work, and other learning activities, you will further develop your abilities to Value, Think, Communicate, and Act. Course outcomes can be found in the course outline at <http://frontdoor.valenciacollege.edu/materials.cfm?uid=JNISS>.

METHOD OF INSTRUCTION:

Instruction will include lectures, discussion of homework assignments, and problem solving sessions with including problem solving using graphing calculators.

STUDENTS WITH DISABILITIES:

Students with disabilities that qualify for academic accommodations must provide documentation from the Office for Students with Disabilities (OSD), preferably in the first two weeks of class. For information contact the Winter Park OSD ([lfirmani@valenciacollege.edu](mailto:lfirmani@valenciacollege.edu) )

ATTENDANCE:

Attendance and class participation are expected of all students. Students are responsible for all material covered in class during any absences and may be withdrawn from the course at the instructor’s discretion if absences are excessive.

HOMEWORK:

Homework is an essential part of this course. Homework will be assigned during each lecture session and is expected to be completed by the next class session. At that time an opportunity to discuss the homework will be given although it is not collected or graded. Make a sincere effort to stay current with homework. Success in the class is unlikely otherwise.

GRADING:

Weekly quizzes or take home projects will count for one third of the final course grade. The two lowest quiz/project grades may be dropped if the student visits the instructor’s office in the first two weeks of the semester and a second time later in the semester. It is the responsibility of the student to sign in to get credit for office visits.

Three exams during the course will contribute another third to the final grade.

The final exam on Tuesday, December 13 from 1:00pm to 3:30pm will make up the remaining third of the grade. The final will be comprehensive, although more stress may be placed on material from later in the course.

MAKE-UPS:

It is my policy NOT to allow make-ups of missed tests or assignments. The only exceptions that will be considered are verifiable absences due to illness, death in the family, or other such unanticipated emergencies. In the event of such a situation, written verification (Dr.'s excuse, police report, etc.) of the emergency must be provided. Note that two quizzes are dropped to allow for the occasional missed class. If you are going to have to miss an exam, you must let the instructor know before the scheduled exam time, and you may be allowed to take the exam early.

WITHDRAWAL:

The withdrawal (W) deadline for this session is Friday, November 11. It is the student’s responsibility to withdraw through Atlas. Withdrawal after the deadline due to attendance is at the discretion of the instructor.

HONESTY:

Representing another's work as your own or allowing such conduct on the part of a fellow student is cheating. Cheating will not be tolerated in this class. Such incidents will be handled according to the college policy on academic honesty.

CLASSROOM CONDUCT:

Students are expected to behave in a manner that encourages an atmosphere of respect in the classroom. The Valencia Community College Code of Student Conduct will be the minimum standard for behavior. In addition to that standard, cell phones will be disabled during class meetings.

GRADING SCALE: 90 - 100 A

80 - 89 B

70 - 79 C

60 - 69 D

below 60 F

NOTICE:

Changes in the procedures described in this syllabus may be made at the discretion of the instructor.

Homework – Exam 1

Chapter 1 1.14, 1.19, 1.34, 1.29, 1.32, 1.33, 1.37, 1.40, 1.42, 1.45

Chapter 2  2.15, 2.16, 2.20, 2.21

Chapter 3  3.15, 3.16, 3.26, 3.29, 3.31, 3.34

On these last 4 problems, only indicate if the DE is Linear or Non-linear (perhaps Bernoulli - but you are not responsible for identifying Bernoulli - only linear or non-linear.)

Please watch this Youtube video to prepare for the next day's lesson.  
Just concentrate on the set-up, not the solution of the DE.  We will get to that soon.  
[Mixture Problem](http://www.youtube.com/watch?v=6wk9zWa-Fww&feature=related): <http://www.youtube.com/watch?v=6wk9zWa-Fww&feature=related>

Chapter 4  4.23, 4.25, 4.27, 4.29, 4.31, 4.34, 4.35, 4.36, 4.37, 4.39, 4.41, 4.43

Chapter 6  6.20, 6.24, 6.27, 6.29, 6.48, 6.50

Chapter 7  [7.26](https://www.youtube.com/watch?v=KHGRl8cNrvI&feature=em-upload_owner), 7.28, 7.30, 7.46, 7.47, 7.48, 7.65, 7.66, 7.67a, 7.68, 7.69, 7.70

On problems 7.66, 7.68 and7.70 the mixture problems have different rates in and out.  Let’s make sure to talk in class about how to handle this case.

Chapter 18 18.19, 18.20, 18.34, 18.35, 18.36

Here's the link to the applet used in class: <http://www.math.jhu.edu/mathcourses/302/jode/JOdeAppletFramed.html>

Phase Line Diagram Supplement: 1, [2a](https://www.youtube.com/watch?v=QVnqH_9n7_Q&feature=em-upload_owner), 6, [7](https://www.youtube.com/watch?v=everSOXYPmg), 8

Here's the Phase Line Supplement: [Qualitative Problems\_1\_\_1\_.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7443552-dt-content-rid-143307813_1/xid-143307813_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7443551_1&course_id=_108165_1#contextMenu)

[Euler's Method on the Calculator](http://screencast.com/t/MWM1OTIxM)

**Homework – Exam 2**

**Chapter 9** 9.17, 9.18, 9.19, 9.20, 9.25, 9.26, 9.29, 9.30, 9.32, 9.33, 9.38, 9.40, 9.44, 9.45

**Chapter 10** 10.21, 10.24, 10.37, 10.39, 10.42, 10.44, 10.46

**Chapter 11 Solved Problems** 11.1- 11.7, 11.8 - 11.10, 11.13, 11.14  
These problems can get very long.  Keep in mind that in a lot of the problems in the homework and the quiz and test, you will just be asked to set up the form for yp and stop.  So you would stop at the line that says yp = .........

**Supplementary Problems** 11.15 - 11.34, 11.36, 11.37, 11.38, 11.40, 11.47 - 11.49  
In questions 11.15 - 11.36 you are only asked to write down the form of yp and stop.  They give you the homogeneous solution yh at the beginning of the set and then in each problem they give you the "forcing function" - that is the function that is on the right side of the DE.  I call it f(x), they call it phi(x).  These are not long since you're just writing down the form of yp so do as many as you can for practice.  Figuring out the form for yp is the hardest part.  
  
In 11.44 - 11.46 you are to solve the DE to the end.  That is solve for all constants in yp.  And if you were to have Initial Conditions, they would be applied at the very end - after you found the constants in the yp and then written the general solution: y = yh+yp.  This is when you solve for C1and C2.

**Chapter 13** 13.9, 13.13

The solution to 13.13 is y = 0.  Can you generalize this problem?  In other words, what is it about the problem that made the answer y = 0 and is that always the case?

**Chapter 14 Solved Problems** 14.9

**Supplementary Problems** 14.26, 14.30, [14.31\*](https://www.educreations.com/lesson/view/springs/1439892/?ref=link), 14.33, 14.36c, 14.38, 14.39, 14.41-14.46

\* This one has a video solution.

Note that when the text says "the force due to air resistance is -2 x with a dot on top of the x" , they're telling you the damping coefficient, Beta is 2.Therefore the DE for number 14.38 would be (1/4)x" +  2x' + 16x = 0.

Note that in number 14.41, you must convert 10 cm into meters.  100 cm = 1  meter.

Also, referring back to your solution for number 14.31 answer the following questions:

a) What is the position of the mass at t = 3sec?

b) What are the amplitude and period of the motion?

c) What is the instantaneous velocity at t = 3 sec?

d) At what time does the mass attain its maximum displacement from the equilibrium position for the first time? And, is it above or below the equilibrium at this time?

[Extra Damping Question-1.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7578169-dt-content-rid-143866229_1/xid-143866229_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7578144_1&course_id=_108165_1#contextMenu)

Solution:  a) beta > 5/2  b) beta = 5/2  c) beta < 5/2

**Homework – Exam 3**

* Please read the information and watch the videos from day 17 Class Notes shown below. Please also print the Laplace Table given there.  You will use this table when you do the HW.

Then try this HW.  We will have a quiz over this material on Wednesday.

**Chapter 21**

**Solved Problems**21.5, 21.6, 21.8 - 21.13 **Supplementary Problems**Solve using the Definition of a Laplace transform: 21.27,21.29,21.31, 21.39, 21.41, 21.42  
Solve using the Laplace Table given below: 21.43, 21.50, 21.62 - 21.67

**Solve all the rest of the HW using the Laplace Table given below.**

**Chapter 22**

**Solved Problems**22.1, 22.2, 22.3 **Supplementary Problems**22.20 - 22.28, 22.33, 22.37

**Chapter 24**

**Solved Problems**  
24.1, 24.4  
**Supplementary Problems**  
24.17, 24.26

**Extra Practice**

There are Homework Pencasts solutions to all of these in the Here's Some Help folder for Day 17 in the Online Course Materials .  
  
Using the Definition:[Definition.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947637_1/xid-142947637_1" \t "_blank) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

Inverse Laplace: [Inverse Laplace.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947638_1/xid-142947638_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)   
  
Solve the DE: y" +9y = 0, y(0) = 4, y'(0) = 2

Day 17 3/16/16

**Chapter 22**

Solved Problems (These are about at the difficulty level I'm expecting)  
22.11, 22.13  - 22.17  
  
Supplementary Problems  
  
22.42, 22.43, 22.46  
  
Remember to use the Laplace table provided - not Appendix A in the Schaum's text!

**Chapter 24**

Supplementary Problems  
24.18, 24.19

**More Practice**

Solutions to these are found in the Homework Pencasts in the Here's Some Help folder for Day 18 in the Online Course Materials.  
  
Inverse Laplace and Partial Fractions: [Partial Fractions.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947635_1/xid-142947635_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

More DEs [More DEs.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947636_1/xid-142947636_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

Day 18 3/21/2016

**Chapter 21**

Solved Problems  
The Property we are learning about in the Schaum's text is called Property 21.2.  So when you're looking at their solutions, they sometimes show many ways to do the same problem.  Make sure you are looking at the one that is using Property 21.2.  Again, you will not have access to the full Laplace Table that they refer to in Appendix A.  
21.14b, 21.15b  
There are 3 more examples of this property shown on the Class Notes Pencast for Day 19.  
There are also 2 more pencast examples in the  Homework Pencasts in the Here's some help Folder.  
  
Supplementary Problems  
Use our Laplace table to do all of these:  
21.30,  21.33, 21.36, 21.45, 21, 47, 21.51, 21.55, 21.57

**Chapter 22**

Solved Problems  
The examples that deal with using the shifting property(their Property 21.2) in reverse are all done using various entries in their exhaustive table.    
However, there are 4 examples worked out in the Class Notes Pencast for day 19.  
There are also 3 more pencast examples in the  Homework Pencasts in the Here's some help Folder.  
  
Supplementary Problems  
22.29, 22.30, 22.34, 22.35, 22.36, 22.38, 22.39, 22.44\*  
\* This one's a little above and beyond - but still good practice.  You'll need Partial Fractions and then the Shifting Property.

**Chapter 24**

Solved Problems  
24.2, 24.3, 24.5- the constants get pretty nasty on this one, but the process is the same.  
There is an example of solving a DE at the end of the Day 19 class notes.  
There is also 1 more pencast example in the  Homework Pencasts in the Here's some help Folder for Day 19.  
  
Supplementary Problems  
24.22, 24.23, 24.28, 24.29

Day 19 3/23/2016

Solved Problems  
23.9 - 23.11  
NOTE:  We are using a slightly different formula for taking the inverse Laplace of Unit Step functions.  
They are using number 9 in our table:  f(t – a)U(t – a) ----> e-asF(s).  Using this form requires more algebra finesse than our number 8 does.  So why is number 9 in our table?  We will use number 9 to go in reverse.  So we have 2 rules for Unit Step functions.  Number 8 is good for going from t to s(frontwards) and number 9 is good for going from s to t (backwards).  We haven't gone backwards yet.   
Since we're doing things a bit differently I am providing lots of video examples!  
  
  
Supplementary Problems  
23.36 - 23. 40, 23.43, 23.48  
You can find video solutions to some of these as well some other examples in the Here's Some Help folder.  
Also, there are LOTS of examples of writing unit step functions in the Class Notes for day 20.

Day 20 3/28/2016

**Chapter 23**

Solved Problems  
There are no solved problems in the Schaum's text for this topic.  There are exercises, but no solved problems.  Therefore, I'm including 2 videos of solved problems here.  There is also an example shown in the Class Notes pencast.  
[Solved Problem 1](http://www.livescribe.com/cgi-bin/WebObjects/LDApp.woa/wa/MLSOverviewPage?sid=SzHt0qlWsgv0)  
[Solved Problem 2](http://www.livescribe.com/cgi-bin/WebObjects/LDApp.woa/wa/MLSOverviewPage?sid=1Mp8TnnhbpWd)  
  
Supplementary Problems  
23.49 - 23.55  
Look in the Here's Some Help folder for Day 21  for videos of solutions to some of these problems.

**Chapter 24**

Solved Problems  
24.9 - this is solving a DE with a unit step function in it.  
24.14, 24.15 - these are pretty easy DE's to solve with Laplace, the only thing that makes them a bit different is they use different letters for the dependent variable and t for the independent variable.  But the same process works - just be mindful of the variable names. For example the Laplace of the function q(t) is Q(s), or just Q.  
  
Supplementary Problems  
24.38, 24.43, 24.44  
No DE's with unit step functions here so take a look at the More Practice worksheet for a couple of problems.

**More Practice - DE's with Unit Step Functions**

Solving DE's with unit step functions:[DE’s with Unit Step Functions.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947634_1/xid-142947634_1" \t "_blank) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

 There are 3 problems given. All have answers given and all have video solutions.

**Day 21 3/30/16   Airplane Group Project**

This is a project I have used in my face to face class each semester.  Its a good review of the methods we've learned during the semester.  Also, it gives you a good real world application of DEs.  [DE Airplane Project(1).pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-144527937_1/xid-144527937_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

This assignment will count as 2 quiz grades. You may do it in groups of up to 4 people or you can go solo. I encourage you to work in groups, assigning each member in the group a part of the project – it is rather lengthy. If you work in a group, one paper will be turned in for the group with each person’s name on the project. You may ask me for help or others in your group, but not members outside of your group.   As this is a graded assignment, you are not allowed to go to the Math Support center for help – or Cramster or other such places. You’ve got ME!!  
  
  
  It is due on April 11th by midnight.    You can send it electronically, but only as a scanned document - no pictures(jpgs) allowed on this one.  Its too long and often the quality of the pictures have not been good.  Otherwise,  you can turn it into the Math department on East Campus: Bldg 7, room 142.  Ask for a receipt.  
  
The project should be done neatly, in pencil.  Your submission should be VERY PRETTY!!! If I can not read it easily, I will not grade it – really. You will be asked to draw several graphs.  All graphs should be computer drawn.  You can Google to find a free grapher, or use Wolfram alpha. Demos is a goodgrapher.  
If you have any questions, please do not hesitate to email me.

**Day 22 4/4/16**

Here's a link to the Review Sheet  
[R3 Online DE.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646790-dt-content-rid-142947631_1/xid-142947631_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

There are ALOT of review materials available in the online folder.  Look under week 12.

* https://learn.valenciacollege.edu/images/ci/sets/set01/document_on.gif

### https://learn.valenciacollege.edu/images/ci/icons/generic_updown.gifClass Notes Day 17

[https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)[Hide Details](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1)

Enabled:

Statistics Tracking

This first day lecture on Laplace Transforms is an important one to watch.  It gives you a "Big Picture" of what's coming in this unit.   
Click on the link to watch the pencast lecture for [Day 17](https://www.youtube.com/watch?v=wKRgKPJWbko).  
  
Please watch this [SHORT](http://screencast.com/t/hUjMpiGc)(less than 5 minutes) video after you have watched the Day 17 lecture notes.  It will explain my thoughts on how to learn about Laplace Transforms in the best way.   
  
  
This is the Laplace Transforms Table we will be using through out this unit.  You will want to print it and keep it handy as you do the homework and watch the lectures.  You will be given this table when you take the test. [Laplace Table.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7646896-dt-content-rid-144252826_1/xid-144252826_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7646788_1&course_id=_108165_1#contextMenu)

  Schaum's refers to Appendix A which is a lengthy table of Laplace transforms.  This table eliminates the need to learn how to use some of the important properties of Laplace Transforms.  This is not the table you will use when taking a test so I would recommend NOT using it when you're working through your homework.

**Homework – After Exam 3**

Chapter 21

21.74\*

Impulse Functions are not covered in Schaum's.  Please download this file for some homework covering this topic:  
[Impulse HW.pdf](https://learn.valenciacollege.edu/bbcswebdav/pid-7691498-dt-content-rid-142947642_1/xid-142947642_1) [https://learn.valenciacollege.edu/images/ci/icons/cmlink_generic.gif](https://learn.valenciacollege.edu/webapps/blackboard/content/listContentEditable.jsp?content_id=_7691494_1&course_id=_108165_1#contextMenu)

\*Look in the Need some help folder for Day 25 for video solutions to these problem as well as  more examples.  
  
Also, the first part of the Class Notes for Day 26 shows another example of a Periodic Function and an Impulse Function

Day  25  4/13/16

Chapter 14

Solved Problems  
14.12, 14.13, 14.15  
  
Supplementary Problems  
14.52\*, 14.53,14.64  
\*See the video solution in the Need Some Help folder.  
  
There is a video solution to a LRC problem using Laplace Transforms in the Need Some Help folder day 26.  You can use either the methods from chapter 14 to solve LRC circuit problems or Laplace transforms.