

# MAT 254.I1 - DIFFERENTIAL EQUATIONS

## COURSE SYLLABUS (WINTER 2021: 1/12/21 TO 4/29/21)

**PROFESSOR:** Steve Tuckey

**EMAIL:** [tuckeysteven@jccmi.edu](mailto:tuckeysteven@jccmi.edu)

**PHONE:** 781.523.9805 (Google Voice)

**LIVE CLASS SESSIONS:** Tuesdays & Thursdays, 9:00-11:00 AM

**OFFICE HOURS:** <http://bit.ly/sftsched> for hours & [appointments](#)

**COURSE MATERIALS:** Available on the course's [JetNet shell](#)

### COURSE DESCRIPTION & OBJECTIVES

#### COURSE DESCRIPTION:

In this course, students will explore solutions of first order differential equations, linear differential equations with constant coefficients, variation of parameters, Laplace transforms, eigenvectors and eigenvalues and application to solution of systems of linear first order equations. Computer access and a graphing calculator are required.

*Prerequisite: 2.0 in the past two years in JC's MAT 154.*

#### MATH 254 CORE COURSE OBJECTIVES:

Successful MAT 254 students will be able to:

- ✓ Solve first-order differential equations that are separable, homogeneous, exact, or linear.
- ✓ Solve second-order differential equations with constant coefficients.
- ✓ Use numerical DE-solving methods to solve a differential equation.
- ✓ Solve systems of differential equations.
- ✓ Solve applications including harmonic motion, damped motion, electrical circuits, growth & decay.
- ✓ Use appropriate technology, including graphing calculator and computer algebra system.

#### MATH 254 GENERAL EDUCATION OUTCOMES:

**GEO 3: Demonstrate computational skills and mathematical reasoning**

- Mathematical Concepts & Tools;
- Language of Mathematics;
- Problem-Solving & Mathematical Modeling;
- Connections.



Comic courtesy of SMBC.com

## COURSE REQUIREMENTS & STRUCTURE

### REQUIRED MATERIALS:

- **Textbook:** *Differential Equations*, 4<sup>th</sup> Edition; by Blanchard, Devaney, and Hall; Thompson - Brooks Cole Publishers (ISBN: 1133109039). This text is available electronically -- **see Steve for more information.**
- **Course Pack of Notes:** Available from the JC Bookstore
- **MAPLE:** Computer software available for discounted purchase (*it is **required** that you have your own access to MAPLE*); Discount Promo Code = **AP191910-37AA1**
- **Scan-to-PDF Technology:** Mobile apps or stand-alone scanner for submitting PDF files
- Computer with **webcam, microphone**, and consistent **internet access**
- **Other:** Large 3-ring binder, large eraser, **pencils**, highlighters, clear (white) printer paper

### TENTATIVE OUTLINE: A brief (and tentative) list of the sections covered in the course

- **Chapter 1: First-Order Differential Equations**
  - 1.1 (Modeling via Differential Equations)
  - 1.2 (Analytic Technique: Separation of Variables)
  - 1.3 (Qualitative Technique: Slope Fields)
  - 1.4 (Numerical Technique: Euler's Method)
  - 1.5 (Existence and Uniqueness of Solutions)
  - 1.6 (Equilibria and the Phase Plane)
  - 1.7 (*Bifurcations*)
  - 1.8 (Linear Equations)
  - 1.9 (Integrating Factors for Linear Equations)
- **Chapter 2: First-Order Systems**
  - 2.1 (Modeling via Systems)
  - 2.2 (The Geometry of Systems)
  - 2.3 (The Damped Harmonic Oscillator)
  - 2.4 (Additional Analytic Methods for Special Systems)
  - 2.5 (Euler's Method for Systems)
- **Chapter 3: Linear Systems**
  - 3.1 (Properties of Linear Systems and the Linearity Principle)
  - 3.2 (Straight-Line Solutions)
  - 3.3 (Phase Portraits for Linear Systems with Real Eigenvalues)
  - 3.4 (Complex Eigenvalues)
  - 3.5 (Special Cases: Repeated and Zero Eigenvalues)
  - 3.6 (Second-Order Linear Equations)
  - 3.7 (*The Trace-Determinant Plane*)
- **Chapter 4: Forcing and Resonance**
  - 4.1 (Forced Harmonic Oscillators)
  - 4.2 (Sinusoidal Forcing)
  - 4.3 (Undamped Forcing and Resonance)
- **Chapter 6: Laplace Transforms**
  - 6.1 (Laplace Transforms)
  - 6.2 (Discontinuous Functions)
  - 6.3 (Second-Order Equations)
  - 6.4 (*Delta Functions and Impulse Forcing*)
  - 6.5 (*Convolutions*)

## ***HOMEWORK & INVESTIGATIONS:***

The single best way to **learn** math is to **do** math. Homework is the persistent, focused practice that fosters learning of skills and concepts. There will be suggested homework associated with each section of material covered, and these are intended as practice (neither collected nor graded). Graded (with partial credit) homework sets and investigations (often team-based) will be assigned *at least* once per week, and will consist of book-sourced problems and instructor-designed exercises. Since homework is all about practice and growth, **“make explicit all your work and reasoning” is a default requirement.** You will receive no credit for required work that appears to be copied from others, MAPLE, or a solutions manual. *Working with* others is never justification for submitting the *work of* others. All assignments will be submitted electronically, either as a single Maple document or a single PDF file. You may use a free, “scan-to-PDF” app for your mobile device (e.g., “Genius Scan” or “Adobe Scan”) to create a single PDF file of separate sheets of paper. **Please note: Late homework will NOT be accepted,** so you must make arrangements for submitting your work by the stated due date.

## ***EXAMINATIONS:***

Examinations are performances of student understanding; as such, they will allow students to demonstrate mastery of the skills and concepts from the homework and lectures. Special requirements (e.g., MAPLE use) and allowances (e.g., notes) will depend upon the particular topics and will be announced in class. The final exam is cumulative for the entire course. As this is an online course, you will be required to complete exams *outside of our class session times* and within a specific time frame announced in advance.

## **COURSE POLICIES**

### ***ATTENDANCE POLICY:***

Students are expected to attend all class meetings, arriving on time, and staying until the end. The student is responsible for obtaining any missed materials from other students or online postings; that is to say, *office hours are not a replacement for class time.* Moreover, **homework and exams may not be made up.** Electronic submission of homework and exams is *due by the specific times that are announced and posted.*

### ***GRADING POLICY AND SCALE:***

A 2.0 or “C” is a passing grade. Only courses with passing grades count toward graduation. Other colleges transfer in only courses with passing grades, though some institutions often have higher transfer standards. Financial aid sources, transferring institutions, and most employers, require *at least* a passing grade for the course to count in a meaningful way.

#### ***Grading Scale:***

90 - 100% → 4.0	65 - 69% → 1.5
85 - 89% → 3.5	60 - 64% → 1.0
80 - 84% → 3.0	50 - 59% → 0.5
75 - 79% → 2.5	0 - 49% → 0.0
70 - 74% → 2.0	

#### ***Weighted Grade Calculation:***

Homework & Investigations: 40%
Midterm Exams: 40%
Cumulative Final: 20%

### ***INCOMPLETE POLICY:***

“A student may request an incomplete from the instructor. The incomplete will be granted only if the student can provide documentation that his or her work up to that point is sufficient in quality, but lacking in quantity, due to circumstances beyond the student's control. Final determination of whether an incomplete will be given is the instructor's decision.” ([JC Policy](#))

**Note:** Seeking an “Incomplete” grade is **not** a valid strategy for avoiding a failing one.

### ***EXTRA CREDIT:***

There will be no opportunities for *extra* credit. Your grade calculation is based solely on your performance on course assignment categories listed above.

### ***ACADEMIC HONESTY POLICY:***

You are *strongly encouraged* to work with each other, but **all your submitted work must be your own**. In other words, working as a group is a great way to learn material, but anything you submit for a grade must be evidence of *your own* thought processes, not the explicit work of someone else. If I suspect you of academic dishonesty, I will follow [JC's Academic Honesty Policy](#) and take appropriate action up to and including assigning a **failing grade** for the assignment, examination, or the course itself (as I deem appropriate).

### ***COURSE EXPECTATIONS:***

*The following are expectations that we can all share.*

**We are each responsible** for our work, our learning, and our behavior.

This course will require consistent, mindful effort on your part. Mathematics is a subject that requires regular, thoughtful practice to understand and master.

**We are each respectful** of everyone in the course (including ourselves).

Please share audio and video during sessions to further communication, minimize any distractions in your environment during sessions, and come prepared & on time to ask/answer questions and work together with your colleagues.

**We are patient and persistent**, even in the face of frustration (with others or ourselves).

Remember, at this level, it is not only understandable to be ‘stumped’ by problems at first, *this is to be expected*. **What separates successful students from unsuccessful ones is almost entirely patient persistence, and a willingness to engage with others.**

**We will communicate with each other promptly** regarding problems or concerns.

Regular, direct communication solves more problems than it causes. Please do not hesitate to contact me for any reason, and I will do the same.

### ***WHERE TO GET HELP:***

Given the level of this course's mathematical sophistication, your fellow students and I are your best resources for learning. Even so, there are many other sources to consider and investigate. Be creative, be resourceful, and *share what you find* -- we're all in this together!

I **strongly** advise that you start up a *regular study group* as soon as you are able with some of your classmates. At the very least, write down names and contact information for your peers and call on each other when needed. For more information on starting and maintaining a study group, check out the following link: <http://bit.ly/math-study-group>.