Differential Equations MATH-3315-002
Department of Mathematics and Statistics
Spring 2020

A. COURSE INFORMATION

Course number/section: MATH – 3315.002
Class meeting time: TR 8:00 - 9:15 AM IH
Class location: 158
Course Website: https://bb9.tamucc.edu

B. INSTRUCTOR INFORMATION

Instructor: Dr. D. Palaniappan (Dr. Pal)
Office location: ENGR 211
Office hours: MW: 9:00-10:30AM, TR: 12:30-1:30PM,
and by appointment

Telephone: 825 (2221)
e-mail: Devanayagam.Palaniappan@tamucc.edu
Appointments: e-mail

C. COURSE DESCRIPTION

Catalog Course Description
Standard types of ordinary differential equations are studied in this course. First, second, and
higher order equations are examined. Students will be entertained with Laplace transforms,
power series method and the basic theory of existence/ uniqueness.

Extended Course Description
The course is enhanced by the computational and graphical capabilities of MATLAB or other
software.

This course utilizes differentiation and integration tools to solve ordinary differential equations
arising in engineering, biological and physical sciences.

D. PREREQUISITES AND COREQUISITES

Prerequisites
MATH 2414 (Calculus II). May be taken concurrently with MATH 3470 (Calculus III).
Students must know all derivative and integration techniques very well.

Co-requisites
None
E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES
   Required Textbook(s)
   Optional Textbook(s) or Other References
   Will be provided as needed

   Supplies
   None

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT
   Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

   By the end of this course, students should be able to:

   1. Identify and classify differential equations (DE).
   2. Solve first-order ordinary differential equations (ODE).
   3. Solve first-order ODE in applications.
   4. Solve higher-order ODE, including applications.
   5. Find power series solutions to ODE.
   7. Approximate a solution to ODE using numerical methods.
   8. Solve system of first order ODEs.

   1. The student will be able to identify and classify differential equations (DE).
      A. Classify a differential equation (DE) by type, order, and linearity.
      B. Show that a given function is a solution to an ordinary differential equation.
      C. Determine the existence of a unique solution to an ODE.
      D. Construct ODE’s as mathematical models.

   2. The learner will be able to solve first-order ordinary differential equations (ODE).
      A. Solve an ODE by separation of variables with or without an initial condition.
      B. Determine if an ODE is exact and solve it if it is exact.
      C. Find the general solution of a linear ODE with and without initial conditions.
      D. Solve a homogeneous and Bernoulli ODE using a substitution.
3. The learner will be able to solve first-order ODE in applications.
   A. Construct a linear ODE as a mathematical model.
   B. Construct a non-linear ODE as a mathematical model.
   C. Construct a system of linear ODE’s as a mathematical model.

4. The learner will be able to solve higher-order ODE.
   A. Solve a nth-order initial-value problem (IVP).
   B. Solve a nth-order boundary-value problem (BVP).
   C. Determine whether given functions are linearly independent or dependent.
   D. Verify that given functions forms a fundamental set of solutions.
   E. Solve ODE’s using undetermined coefficients.
   F. Solve ODE’s by variation of parameters.
   G. Solve a system of ODE’s by systematic elimination or determinants.
   H. Solve non-linear equations using a substitution.
   I. Construct ODE’s as mathematical models to initial-value problems.

5. The learner will be able to find power series solutions to ODE.
   A. Find the interval of convergence of a power series.
   B. Solve ODE’s using power series.

6. The learner will be able to solve ODE using the Laplace transform.
   A. Find the Laplace transform of a given function.
   B. Find the inverse Laplace transforms.
   C. Solve ODE’s using Laplace transforms.

7. The learner will be able to approximate a solution to ODE using numerical methods.
   A. Create direction fields for ODE’s.
   B. Approximate a solution to a ODE using Euler’s and the improved Euler’s method.
   C. Approximate a solution to an ODE using Runge-Kutta methods.

8. The learner will strengthen his or her general academic skills (critical thinking, writing, verbal explanation, working collaboratively, assuming responsibility, and use of technology).

9. The learner will develop a broad base of differential equations knowledge: Concepts, Basic skills, mathematical senses (quantitative, geometric, symbolic), and thinking process (problem solving, predicting, and generalizing)

G. INSTRUCTIONAL METHODS AND ACTIVITIES

A variety of instructional methods may be used depending on content area. These include but are not limited to: lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

H. MAJOR COURSE REQUIREMENTS AND GRADING

Homework will be assigned in class along with the due date. No credit for late homework. Quizzes will be given in class. At the end of the semester the lowest homework/quiz grade gets dropped.

Project: Each student will select a topic to describe a physical problem from engineering or other disciplines. The problem should be such that its mathematical model uses the concepts
of this course. Project paper (report) should include the following:

- a. Statement of the problem
- b. Its Mathematical Model
- c. Analytical/numerical results of the model
- d. Interpretation of the results

Grades will be calculated based on the following

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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<tbody>
<tr>
<td>Exams</td>
<td>50%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Project Report</td>
<td>5%</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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</tbody>
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Grading scale:
A = 90% – 100%
B = 80% - 89%
C = 70% - 79%
D = 60% - 69%
F = Below 60%

I. COURSE CONTENT/SCHEDULE

<table>
<thead>
<tr>
<th>Week of</th>
<th>Topic</th>
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<tbody>
<tr>
<td>Jan 20</td>
<td>Intro. to Differential Equations (DE): Classification, Solutions, Existence, and Models</td>
</tr>
<tr>
<td>Jan 27</td>
<td>First Order DE: Separation of variables and Exact equations</td>
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<tr>
<td>Feb 03</td>
<td>First Order DE: General solutions and Substitutions</td>
</tr>
<tr>
<td>Feb 10</td>
<td>Modeling with First Order DE: Linear, Non-linear and Systems</td>
</tr>
<tr>
<td>Feb 17</td>
<td>Higher Order DE: Initial and Boundary-value equations</td>
</tr>
<tr>
<td>Feb 24</td>
<td>Test #1</td>
</tr>
<tr>
<td>Mar 02</td>
<td>Higher Order DE: Linear Independence and Fundamental Set</td>
</tr>
<tr>
<td>Mar 16</td>
<td>Higher Order DE: Undetermined Coefficients and Variation of Parameters</td>
</tr>
<tr>
<td>Mar 23</td>
<td>Modeling with Higher Order DE</td>
</tr>
<tr>
<td>Mar 30</td>
<td>Test #2</td>
</tr>
<tr>
<td>April 06</td>
<td>Series solutions of linear DE</td>
</tr>
<tr>
<td>April 13</td>
<td>Laplace Transform</td>
</tr>
<tr>
<td>April 20</td>
<td>Systems of differential equations</td>
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April 27  
Test #3, Numerical Methods of ODE

May 04  
Review

FINAL EXAM: Tuesday May 12, 2020, 8:00 – 10:30AM

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES

Attendance/Tardiness
Attendance will be taken each class. Attending class is a faster way of learning the material than trying to catch up on missed material solely from the book. Tardiness is often disruptive to the whole class and is not appreciated. **Do not disrupt** the class. Any disruption will lead to heavy penalty decided by the instructor.

Late Work and Make-up Exams
Missed homework assignments cannot be made up. At most one make-up exam will be scheduled for each exam. Make-up exams tend to be harder than the original exam.

Extra Credit
There is no extra credit in this class.

Cell Phone Use
Cell phones and such must be turned off before class. Each time your phone rings during class, your course grade goes down by 1%

Laptop Use
You may use a laptop to take notes during lecture. Distracting other students by surfing the web is not acceptable behavior.

Food in Class
No food in class (except during the final, where non-noisy foods are OK).

Missed Exam
If you have to miss an exam, it is your responsibility to contact me **no later than the day of the exam.** Failure to contact me on or before the exam day results in a grade of zero points for the exam. This also applies to the final exam. For missed final exams due to an acceptable excuse the university rules about I (Incomplete) grades apply and the make-up is at the instructor's convenience early in the next long semester. Only extreme emergencies or official university business are acceptable reasons to miss exams and documentation will be required. Car trouble, routine doctor's appointments,
family reunions or graduations of siblings etc. are not valid reasons to miss exams. If your reason to miss the exam is not a valid one, your exam score is 0 points. Be sure to check before missing an exam whether your reason is acceptable.

**Participation**
Participation is not part of the grade, but you learn more by interacting, than by watching passively.

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**K. COLLEGE AND UNIVERSITY POLICIES**

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  - Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course. Should dropping the course be the best course of action,
you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- Grade Appeals (College of Science and Engineering)
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- Disability Services
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  http://disabilityservices.tamucc.edu/

- Statement of Academic Continuity
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi, this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be
operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. OTHER INFORMATION

• Academic Advising
The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER
I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.