Differential Equations
MATH 2120

Catalog Course Description:

A first course in differential equations emphasizing solution techniques. Includes first-order equations and applications, theory of linear equations, basic second-order equations and applications, Laplace transforms, and series solutions.

Entry Level Standards:

A thorough knowledge of algebraic, trigonometric, and beginning through multivariable calculus functions is necessary for entrance to this course.

Prerequisites:

MATH 1920

Textbook(s) and Other Reference Materials Basic to the Course:

Textbook:

References:

Personal Equipment:
A graphing calculator is required. The TI-83 or TI-83 Plus is recommended.

I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Definitions and Terminology, Initial-value Problems, Direction Fields, Euler's Method; 1.1-1.3, 1.5</td>
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<tr>
<td>2</td>
<td>Phase Portraits, Introduction to motion of a falling body, Separable Equations; 1.4, 2.1-2.2</td>
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<td>3</td>
<td>Linear equations, exact equations; 2.3, 2.4</td>
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<td>4</td>
<td>Substitutions and Transformations; 2.6</td>
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<td>5</td>
<td>Compartmental analysis, Heating and cooling, Newtonian mechanics; 3.2-3.4</td>
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<tr>
<td>6</td>
<td>Linear differential operators, fundamental solutions of homogeneous equations; 4.2, 4.3</td>
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<tr>
<td>7</td>
<td>Reduction of order, homogeneous linear equations with constant coefficients, auxiliary equations with complex roots, superposition and nonhomogeneous equations; 4.4 - 4.7</td>
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II. Course Objectives*:

A. Gain a working knowledge of first- and second-order differential equations and their solutions. VI.2,3,4,5,6

B. Apply the concepts of differential equations to suitable mathematical models. VI.2,3,4,5,6

C. Scrutinize solution techniques comparatively (graphical, numerical, symbolic, transforms, etc.). VI.2,3,4,5,6

*Roman numerals after course objectives reference TBR’s general education goals.

III. Instructional Processes*:

Students will:

1. Employ graphing calculators and/or computer software as tools for the field of study.  
   *Technological Literacy Outcome*

2. Advance their skills in analysis, synthesis, symbol manipulation, graphical conceptualization and technical writing skills using the work and/or projects assigned.  
   *Mathematics Outcome, Numerical Literacy Outcome, Communication Outcome, Transitional Strategy*

3. Analyze real life problems such as: using first order differential equations to construct compartmental analysis, to investigate Newtonian mechanics models as well as heating and cooling models, and to analyze population growth. In addition, second order differential equations would be used to explain mechanical vibration, spring/pendulum, harmonic motion and forced oscillation models.  
   *Mathematics Outcome, Transitional Strategy*

4. Actively engage in student-led discussions and brainstorming sessions about the mathematical/physics based models inherent to the course.  
   *Active Learning Strategies, Transitional Strategies*

5. Investigate and justify the engineering concepts contained in fields of dynamics and circuit analysis.  
   *Mathematics Outcome, Transitional Strategy*

*Strategies and outcomes listed after instructional processes reference TBR’s goals for strengthening general education knowledge and skills, connecting coursework to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

IV. Expectations for Student Performance*:

Upon successful completion of this course, the student should be able to:
1. Solve "separable", "exact", "integrating factor" and "Bernoulli" first order differential equations symbolically. A

2. Apply first order differential equations solution techniques to mathematical models (including: population, heating/cooling, compartmental analysis, Newtonian mechanics, terminal velocity, and logistic models). B

3. Define the numerical solutions (Euler's Method) to first order differential equations. C

4. Illustrate familiarity with graphical solutions to first order differential equations using direction fields. C

5. Determine the best method (graphically, numerically, or symbolically) of solving first order differential equations. C

6. Calculate general and particular solutions to second order linear homogeneous and nonhomogeneous equations with constant coefficients (using "auxiliary equations", "undetermined coefficients" and "variation of parameters" techniques). A

7. Apply second order differential equation solution techniques to mathematical models (including compartmental, mechanical vibration, spring and pendulum models) B

8. Analyze the behavior of the second order solutions for ordinary differential equations. A

9. Use Laplace transforms and translation theorems to find differential equation solutions. A

10. Find solutions to systems of differential equations using Laplace transforms. A

11. Determine series solutions (Taylor and power series) to differential equations. A

*Letters after performance expectations reference the course objectives listed above.

V. Evaluation:

A. Testing Procedures:

   Students are evaluated primarily on the basis of tests, quizzes, homework, and the comprehensive final exam. A minimum of 4 major tests and the comprehensive is recommended.

B. Laboratory Expectations: N/A

C. Field Work: N/A

D. Other Evaluation Methods: N/A

E. Grading Scale:

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>93 - 100</td>
<td>A</td>
</tr>
<tr>
<td>88 - 92</td>
<td>B+</td>
</tr>
<tr>
<td>83 - 87</td>
<td>B</td>
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VI. Policies:

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student Affairs, may have requirements that are more stringent.

B. Academic Dishonesty:

Cheating, including but not limited to unauthorized assistance from material, people, or devices when taking a test, quiz, or examination; writing papers or reports; solving problems; or completing academic assignments.

In addition to other possible disciplinary sanctions that may be imposed as a result of academic misconduct, the instructor has the authority to assign either (1) an F or zero for the assignment or (2) an F for the course.

C. Accommodations for Disabilities:

Students who need accommodations because of a disability, who have emergency medical information to share, or who need special arrangements in case the building must be evacuated, should inform the instructor immediately. The student should speak with the instructor privately after class or in his/her office. Students must present a current accommodation plan from a staff member in Services for Students with Disabilities (SSWD) in order to receive accommodations in this course. To request accommodations students must register with Services for Students with Disabilities: Goins 127 or 131, Phone: (865) 539-7153 or (865) 694-6751 (Voice/TTY).

D. Make-up work:

Instructor discretion about make-up tests and/or assignments.

E. Cell phones:

Cell phones are to be either turned off or put on vibration mode while in class. Instructor discretion as to penalty.

Posted: February 20, 2007