Course Number and Title: MAT 292 Engineering Math I

Campus Location:
Georgetown, Dover, Stanton

Effective Date:
2020-52

Prerequisite:
MAT 283 or concurrent

Co-Requisites:
None

Course Credits and Hours:
3.00 credits
3.00 lecture hours/week
1.00 lab hours/week

Course Description:
In this course, students apply fundamental mathematical procedures and processes to solve engineering problems. Topics consist of solutions of linear algebraic equations, Gauss elimination, vector spaces, subspaces, linear dependence, linear ordinary differential equations of 2nd order and higher, initial value and boundary value problems, eigenvalues, coupled linear ordinary differential equations, and nonlinear differential equations. This course includes problems and exercises drawn from the areas of circuit theory and mechanical oscillators.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
Graphing calculator

Schedule Type:
Classroom Course
Video Conferencing

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Classify, verify, and determine the existence and uniqueness of solutions to ordinary differential equations. (CCC 2, 6)
2. Solve problems involving applications of first-order differential equation. (CCC 2, 6)
3. Solve problems involving applications of higher-order differential equation. (CCC 2, 6)
4. Use numerical techniques to solve problems involving ordinary differential equations. (CCC 2, 6)
5. Perform basic vector operations on vector spaces. (CCC 2, 6)
6. Perform matrix operations, and use them to solve application problems. (CCC 2, 6)
7. Solve systems of first-order differential equations. (CCC 2, 6)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Classify, verify, and determine the existence and uniqueness of solutions to ordinary differential equations.
    1. Classify differential equations by type, order, and linearity.
    2. Verify that given functions are solutions of defined differential equations.
    3. Examine initial value problems (IVP) to determine existence and uniqueness of solutions.
    4. Construct differential equations from models of selected physical and engineering systems.
2. Solve problems involving applications of first-order differential equation.
    1. Construct and examine direction fields to obtain the solution for a given differential equation.
    2. Solve first-order differential equations and IVP using separation of variables.
    3. Solve linear first-order differential equations and IVP using integrating factors.
    4. Solve exact differential equations and IVP.
    5. Solve Bernoulli's equations and nonlinear differential equations using substitutions.
    6. Construct and solve linear and nonlinear first-order differential equations from physical models.
3. Solve problems involving applications of higher-order differential equations.
    1. Distinguish between IVP and boundary value problems (BVP).
    2. Distinguish between solutions of homogeneous and nonhomogeneous higher-order differential equations.
    3. Employ the reduction of order method to obtain the second solution of a higher-order differential equation.
    4. Find the general solution of a linear homogeneous differential equation.
    5. Determine the general solution of a linear nonhomogeneous differential equation using the method of undetermined coefficients.
    6. Use variation of parameters to solve linear differential equations.
    7. Construct and solve differential equations and IVP for mass-spring and analog circuits systems.
    8. Solve applications of BVP in statics.
4. Use numerical techniques to solve problems involving ordinary differential equations.
    1. Use the Euler and Runge-Kutta methods to approximate the solution of simple differential equations.
    2. Calculate the errors in using the Euler and Runge-Kutta methods to solve first-order differential equations.
    3. Use a numerical solver employing the Euler and Runge-Kutta methods to solve first-order differential equations.
5. Perform basic vector operations on vector spaces.
    1. Add, subtract, multiply, and perform scalar and dot product operations on vectors.
    2. Determine the equations of lines and planes, and the intersection points of these algebraic elements.
    3. Define *vector space* and *subspace*.
    4. Determine the basis and dimension of a given vector space.
    5. Prove linear independence or dependence of a set of vectors.
6. Perform matrix operations, and use them to solve application problems.
    1. Perform matrix algebra on systems of matrices.
    2. Solve systems of linear equations using Gaussian elimination and Gauss-Jordan elimination.
    3. Determine the rank of a matrix, and use this rank to determine consistency of the solutions to a system of linear equations.
    4. Determine the value of the determinant of a matrix.
    5. Solve applied problems using properties of determinants.
    6. Determine the inverse of a given matrix, and solve systems of linear equations using the inverse matrix.
    7. Solve systems of linear equations using Cramer's rule.
    8. Determine the eigenvalues and eigenvectors of a given matrix.
7. Solve systems of first-order differential equations.
    1. Summarize the properties of systems of first-order differential equations.
    2. Solve systems of first-order homogeneous differential equations using systematic elimination.
    3. Solve systems of first-order homogeneous differential equations using both eigenvalue and diagonalization methods.
    4. Solve systems of first-order nonhomogeneous differential equations.

Evaluation Criteria/Policies:
Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	**–**	**100**	**=**	**A**
83	**–**	**91**	**=**	**B**
75	**–**	**82**	**=**	**C**
0	**–**	**74**	**=**	**F**

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
3 Unit Tests (Summative) (Equally Weighted)	45%
Final Exam (Summative)	25%
Programming Assignments (Formative) (Equally Weighted)	10%
Other – Homework, Quizzes (Formative) (Equally Weighted)	20%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):
None

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.