THE COLLEGE OF NEW JERSEY
DEPARTMENT OF ENGINEERING
ENG 272 – ADVANCED ENGINEERING MATH I

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Text: ADVANCED ENGINEERING MATHEMATICS, 5th Edition by Zill and Cullen, 2014

COURSE DESCRIPTION:

Integrated introduction to standard topics in differential equations and matrix algebra, and introduction to basic linear algebra. Topics include: first order and higher order differential equations, linear systems, basis, vectors matrices, eigenvalue and eigenvector problems, and experimental design with computer applications to engineering.

COURSE OBJECTIVES:

1. To understand first order and higher order differential equations and their engineering use.
2. To understand and solve systems of differential equations and be able to apply them to practice problems.
3. To understand the Laplace Transform and its engineering use.
4. To understand and apply vectors and matrices to engineering problems.

PERFORMANCE CRITERIA:

1. The student will be able to derive the differential equations of various systems and apply methods (initial and boundary value problems) to obtain solutions satisfying conditions that are given in the physical situation.
2. The student will be able to apply the Laplace Transform to practical problems.
3. The student will apply matrix and vector algebra to engineering problems.

ACADEMIC INTEGRITY POLICY:

The College of New Jersey is a community of scholars and learners who respect and believe in academic integrity. *AT MY DISCRETION, ANYONE VIOLATING THIS POLICY WILL RECEIVE A FAILING GRADE FOR THE ASSIGNMENT OR FOR THE SEMESTER. Please read the TCNJ Academic Integrity Policy:* **http://academicaffairs.pages.tcnj.edu/college-governance/policies/academic-integrity/**

> *CHEATING IS NOT JUST A MISTAKE. CHEATING DEFINES A CHARACTER.*

GRADING: *See TCNJ Grading Policy:* **http://recreg.pages.tcnj.edu/grading-system/**

EXAMS	40%	(Missed exams will receive a zero grade)
QUIZZES	15%	(Lowest quiz grade is dropped)
COMPUTER PROBLEMS	15%	
CUMULATIVE FINAL EXAM	30%	
	100%	

ATTENDANCE:

YOU ARE EXPECTED TO COME TO EVERY CLASS. If you miss a class due to an extraordinary circumstance you are responsible for any assignments or work missed during the absence. I will post notes and assignments on SOCS.
USE OF CELL PHONES AND LAPTOPS IS STRICTLY FORBIDDEN IN MY CLASSROOM.

EXAMS AND QUIZZES:

You will be assigned a zero grade for missed exams. If you miss an exam due to an *extraordinary circumstance*, and you notify me by email, the respective portion of the final will count as your exam grade. You will be given quizzes periodically throughout the course of the semester. I drop the lowest quiz grade.

COMPUTER PROBLEMS:
You will be assigned computer problems from each chapter using MATLAB. These computer assignments will are to be accompanied by hand solutions when applicable. You will also be assigned problems that can ONLY be solved using MATLAB. You may consult with your fellow engineers regarding procedure, but the work handed in MUST BE YOUR OWN. Please see TCNJ Academic Integrity policy.

HOMEWORK:
Homework is to be completed on a regular basis. It will not be collected but will prepare you for the exams and the quizzes. Quiz questions are taken directly from the homework problems.

ACADEMIC CALENDAR:
The last day to withdraw from this course is 10/29/2103.
http://tcnj.pages.tcnj.edu/academics/academic-calendars/academic-calendar-2013-2014/

EDUCATIONAL OBJECTIVES:
The School of Engineering at The College of New Jersey seeks to prepare its graduates:
- To contribute to the economic development of the nation through the ethical practice of engineering
- To become successful in their chosen career path, whether it is in the practice of engineering or science, or in other complimentary disciplines.
- To assume leadership roles in industry or public service through engineering ability, communication skills, teamwork, understanding of contemporary global and socio-economic issues, and use of modern engineering tools.
- To maintain career skills through life-long learning and be on the way towards achieving professional licensure

ENGINEERING PROGRAM OUTCOMES:
What TCNJ engineering students are expected to know and be able to do at graduation; what knowledge, abilities, tools and skills the program gives the graduates to enable them to accomplish the educational objectives.

ENGINEERING GRADUATES WILL HAVE:
- An ability to apply knowledge of mathematics, science, and engineering;
- An ability to design a system, component, or process to meet desired needs;
- An ability to function in multidisciplinary teams;
- An ability to identify, formulate, and solve engineering problems;
- An understanding of professional and ethical responsibility;
- An ability to communicate effectively;
- The broad education necessary to understand the impact of engineering solutions in a global and societal context;
- A recognition of the need for and an ability to engage in life-long learning;
- A knowledge of contemporary issues;
- An ability to use the techniques, skills and modern engineering tools necessary for engineering practice;
- An ability to analyze and design complex electrical and electronic devices;
- An ability to analyze and design software and systems containing hardware and software components;

SPECIFIC TO THIS COURSE:
- An ability to apply knowledge of mathematics, science and engineering:
  - First order differential equations; higher order differential equations, the Laplace transform, series solutions of differential equations, vectors, matrices, systems of differential equations.

	ENG 272: ADVANCED ENGINEERING MATHEMATICS I *TENTATIVE* SCHEDULE	*Complete these problems using MATLAB.
WEEK	*TOPIC(S)*	**SUGGESTED PROBLEMS**
1	**CHAPTER 1: *Introduction to Differential Equations*** Definitions and terminology; Initial-value problems; Differential equations as mathematical models.	1.1 #1, 5, 13, 21, 23, 27; 1.2 #1, 3, 7, 9, 13, 19, 31, 35; 1.3 #5, 7, 13, 15
2	**CHAPTER 2: *First-Order Differential Equations*** *Sections 2.1 – 2.4:* Solution curves without a solution; Separable variables; Linear equations; Exact equations.	2.1 #1, 3, 5, 7, 13; 2.2 5-17 odd, 51*; 2.3 13-19 odd, 27, 33; 2.4 #5-15 odd.
3	*Sections 2.5, 2.6, 2.7, 2.9:* Solutions by substitution; Euler's Method, Linear models; Modeling with systems of first-order ODEs.	2.5 #1, 3, 5; 2.6 #1, 3, 5*, 7*, 9* 2.7 #3, 13, 31, 35; 2.9 #7, 11, 13*
4	**CHAPTER 3: *Higher-Order Differential Equations*** *Section 3.1:* Initial –value and boundary-value problems for homogeneous and non-homogeneous differential equations. *EXAM #1 (Chapters 1and 2)*	3.1 #1, 3, 5, 7*, 9, 21, 23, 33*
5	*Sections 3.2 – 3.3:* Reduction of order; constant coefficients.	3.2 #5-15 odd, 17, 19; 3.3 #7-19 odd, 29, 31, 37, 39
6	*Sections 3.4 – 3.6:* Undetermined coefficients; Variation of parameters; Cauchy-Euler equation.	3.4 #5-15 odd, 21, 25, 27, 29, 33*, 37*; 3.5 #5, 7, 9, 19, 21; 3.6 #5, 7, 9, 25, 27, 31, 33
7	*Sections 3.8 – 3.10, 3.12:* Linear models: initial and boundary value problems; Green's Functions; Solving systems of equations.	3.8 #1-7 odd; 3.9 #1, 3, 11, 27; 3.10 # 3, 7, 13; 3.12 #3, 7, 11, 21, 23*
8	**CHAPTER 4: *The Laplace Transform*** *Section 4.1:* Definition; Inverse transforms and transforms of derivatives. *EXAM #2 (Chapter 3)*	4.1 # 1, 5, 9, 15, 19*, 29*, 37
9	*FALL BREAK* *Section 4.2:* Translation theorems.	4.2 #1, 5, 9*, 15*, 27*, 31, 33, 35
10	**CHAPTER 7: *Vectors*** *Sections 7.1 – 7.4:* Vectors in 2 and 3 D space; Dot product; Cross product.	7.1 #1, 5, 7, 9, 13, 15, 21, 25, 29; 7.2 1, 7, 11, 17, 21, 25; 7.3 #3, 5, 9, 13, 15; 7.4 #1, 3*, 5*, 7*, 9, 13, 17, 45
11	**CHAPTER 8: *Matrices*** *Sections 8.1 – 8.3:* Matrix algebra; Systems of linear algebraic equations; Rank. *EXAM #3 (Chapters 4 and 7)*	8.1 #11, 15*, 17, 19, 21, 23*; 8.2 #1-9 odd, 11*, 15* 8.3 # 1, 3, 5, 11,13
12	*Sections 8.4 – 8.7:* Determinants; Properties of determinants; Inverse of a matrix; Cramer's Rule.	8.4 #5-13 odd, 15*, 17*; 8.5 #13-21 odd; 8.6 #1, 7, 13, 23, 31, 33; 8.7 #3, 5, 9, 11
13	*Sections 8.8– 8.10, 8.12:* Eigenvalue problem; Powers of matrices; Orthogonal matrices; Diagonalization.	8.8 #3, 5, 7, 13, 17; 8.9 #3, 5, 7; 8.10 #3, 7, 9, 13, 15*, 17*, 21*; 8.12 #3, 7, 11, 21, 31
14	**CHAPTER 10: *Systems of Linear Differential Equations*** *Sections 10.1 – 10.2:* Theory of linear systems; Homogeneous linear systems. *EXAM #4 (Chapter 8)*	10.1 #5, 9, 13, 17; 10.2 #3, 5, 7, 13;
TBD	*CUMULATIVE FINAL EXAM*	

SUPPLEMENTARY RESOURCES

- **ADVANCED ENGINEERING MATHEMATICS, 9th Edition, by Erwin Keyszig, Wiley, 2006, ISBN 0-471-48885-2.**

- **MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES, 3rd Edition, by Mary Boas, Wiley, 2006, ISBN 0-471-19826-9.**

- *MATLAB® FOR ENGINEERS*, **Third Edition, by Holly Moore, Pearson, 2012. ISBN 987-0-13-210325-3**

- **MATHEMATICAL METHODS FOR PHYSICS AND ENGINEERING, 3rd Edition, by Riley, Hobson, Bence, Cambridge University Press, 2006, ISBN 987-0-521-86153-3.**

- **ADVANCED ENGINEERNG MATHEMATICS, 4th Edition, by K. A. Stroud, Industrial Press, 2003, ISBN 0-8311-3169-1.**

- **ADVANCED ENGINEERING MATHEMATICS WITH MATLAB, 2nd Edition, by Dean G. Duffy, Chapman and Hall/CRC, 2003, ISBN 1-58488-349-9.**

- **MATLAB Tutorial:**
  http://www.math.ufl.edu/help/matlab-tutorial/matlab-tutorial.html#SEC7