

**FAYETTEVILLE STATE UNIVERSITY**  
**College of Arts and Sciences**  
**Department of Mathematics and Computer Science**

**COURSE SYLLABUS**

**Fall 2010**

**I. LOCATION INFORMATION:**

Course Number & Name: Math 320-01 Difference Equations  
Semester Hours of Credit: 3

Time Class Meets: TR: 9:30-10:45am . Where Class Meets SBE212  
Instructor's name: Dr. Bo Zhang. Office Location: SBE 348

Office Telephone: 672-1786  
E-mail Address: [bzhang@uncfsu.edu](mailto:bzhang@uncfsu.edu)  
Website: <http://faculty.uncfsu.edu/bzhang>

Office Hours: TR: 1:00-3:30pm & 6:00-7:30pm  
Department Office Location: SBE 339  
Department Office Telephone: 672-1294

**FSU Policy on Electronic Mail:** Fayetteville State University provides to each student, free of charge, an electronic mail account ([username@uncfsu.edu](mailto:username@uncfsu.edu)) that is easily accessible via the Internet. The university has established FSU email as the primary mode of correspondence between university officials and enrolled students. Inquiries and requests from students pertaining to academic records, grades, bills, financial aid, and other matters of a confidential nature must be submitted via FSU email. Inquiries or requests from personal email accounts are not assured a response. The university maintains open-use computer laboratories throughout the campus that can be used to access electronic mail. **Rules and regulations governing the use of FSU email may be found at <http://www.uncfsu.edu/PDFs/EmailPolicyFinal.pdf>**

**II. COURSE DESCRIPTION:**

An introductory course in difference equations and discrete dynamical systems, including studies of difference calculus, first order difference equations, higher order linear difference equations, basic theory of linear systems of difference equations, linear periodic systems, stability theory, Liapunov's second method, Z-transform, Asymptotic behavior of solutions. Prerequisite: Math 241 and Math 251.

**III. DISABLED STUDENT SERVICES:**

In accordance with Section 504 of the 1973 Rehabilitation Act and the Americans with Disabilities Act (ACA) of 1990, if you have a disability or think you have a disability to please contact the Center for Personal Development in the Spaulding Building, Room 155 (1<sup>st</sup> Floor); Tel: 910-672-1203.

**IV TEXTBOOK:**

- (a) Textbook: Water G. Kelley and Allan C. Peterson, Difference Equations: An Introduction with Applications, 2<sup>nd</sup> Edition, Academic Press, San Diego, CA, 2001.
- (b) Calculator: Graphing Calculator.
- (c) Mathematical Software: Maple V9

**V. STUDENT LEARNING OUTCOMES:**

Upon completion of this course, students will be able to:

Demonstrate the knowledge of difference calculus: the difference operator and summations.

Demonstrate the ability to solve linear difference equations: general theory, method, and applications.

Demonstrate the knowledge of stability theory of difference equations: linear systems, Floquet theory, and Liapunov's method.

Demonstrate the ability to use asymptotic method to solve and approximate solutions of linear and nonlinear difference equations.

Demonstrate the knowledge of the self-adjoint second order linear equations: Sturmian theory and asymptotic behavior of solutions.

Demonstrate the ability to use mathematical software such as MapleV to solve practical problems related to difference equations.

**VI. Course Objectives and Competencies:**

To provide necessary background in difference equations for students in mathematics, computer science, engineering, physics, chemistry, and other science fields. After the completion of this course, students will have a working knowledge of the basic approaches for analyzing difference equations and be able to use mathematical software such as Maple to solve some practical problems.

Competencies (DPI)

- (11.1) Develop and analyze algorithms for computational efficiency.
- (11.2) Develop skills in using interactive and recursive techniques in solving problems.
- (11.3) Use computers and graphing calculators to estimate solutions to equations
- (11.4) Use computers and graphing calculators to explore mathematical concepts.
- (11.5) Use computers and graphing calculators to explore mathematical concepts.

NCATE Standards

- (1.1.1) Use a problem-solving approach to investigate and understand mathematical concept.
- (1.1.2) Formulate and solve problems from both mathematical and everyday situations.
- (1.2.1) Communicate mathematical ideas in writing, using everyday and mathematical language, including symbols.
- (1.3.0) Make and evaluate mathematical conjectures/arguments and validate their own mathematical thinking.
- (1.4.1) Show an understanding of interrelationships within mathematics.
- (1.4.2) Connect mathematics to other disciplines and real-world situations.
- (1.5.2) Understand and apply numerical computational and estimation techniques and extend them to algebraic expressions.
- (1.6.1) Use calculators in computational and problem-solving situations.
- (1.6.2) Use computer software to explore and solve mathematical problems.
- (2.2.0) Use graphing calculators, computers and other technologies as tools for teaching.
- (2.4.0) Use a variety of resource materials such as software, print materials, technology, and activity files to enhance the learning of mathematics.
- (2.5.0) Select appropriate mathematical tasks that will stimulate students' development of mathematical concepts and

skills.

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## **VII. Course Requirements and Evaluation Criteria:**

Major tests or projects will be given at the completion of each chapter. The lowest chapter test grade will be dropped. A comprehensive final will be given at the conclusion of the course. The grading scale and weights given to various activities for evaluation are listed below.

Tests - 60%, Homework & Class Commitment- 15%, Projects 5%, Final Exam – 20%

A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F= below 60%

### **Course Requirements:**

1. It is the responsibility of the students to avail themselves of all class meetings, tutorial sessions, and individual help from their instructors. Additional tutorial services are provided by Student Services in the Helen T. Chick Building. There are Computer software tutorials available for your use in the Helen T. Chick Building, 2nd Floor and SBE 214.

2. Students are responsible for maintaining a notebook of problems selected by the instructor. Students are encouraged to include as many additional problems as possible.

3. There are four chapter tests. All tests will be announced well in advance of their administration. A make-up test will be given only if the student has a documented and valid written justification for unavoidable absence from the test. There is no more than one make-up exam for each student during the semester. The final examination is cumulative, i.e., it covers the contents of all chapters.

4. Students are expected to enter the classroom on time and remain until the class ends. Three late arrivals and early departures will constitute an absence from the class. The detailed attendance policy may be found in the FSU Catalogue 2009-2010.

5. Students must refrain from smoking, eating and drinking in the classroom. The rights of others must be respected at all times.

6. Students are encouraged to ask questions of the instructor in class and to respond to those posed by the instructor. They should not discourage others from raising or answering questions. Often, other students have the same questions which they wish to ask, but are hesitant to do so.

7. Students are expected to complete all class assignments and to spend adequate time on their class work to insure that the course outcomes are met. At least two hours of home study is expected for each class hour.

8. Talking in class between students is strictly unacceptable. Discussions should be directed to the instructor.

9. Dishonesty on graded assignments will not be tolerated! Students must neither give nor receive any assistance on any work to be graded. the University's cheating policy will be applied for any violations. The minimum penalty will be a grade of zero (0) on the assignment.

## **VIII. COURSE OUTLINE (SEE ATTACHED SCHEDULE)**

**\* SUBJECT TO CHANGE FOR THE OPTIMUM BENEFIT OF THE CLASS**

## IX. Teaching Strategies:

The majority of the material of the course will be given in lecture format. There is a short review before and after each lecture. There will be a comprehensive review after the completion of each chapter. Graphing calculators will be used in the class to help students develop a firm grasp of the underlying mathematical concepts. A help session will be set up after the first week to provide tutorial assistance for students in this class.

## X. References and Academic Support Resources:

1. Saber Elaydi, An Introduction to Difference Equations, Third Edition, Springer Science+ Business Media, Inc., New York, NY 2005.
2. V. Lakshmikantham and D. Trigiante, Theory of Difference Equations: Numerical methods and Applications, Academic Press, New York, NY, 1988.
3. V. L. Kocic and G. Ladas, Global Behavior of Nonlinear Difference Equations of High Order with Applications, Kluwer Academic Publishers, Boston, MA, 1993.
4. Pavi P. Agarwal, Difference Equations and Inequalities: Theory, Method, and Applications, Marcel Dekker, New York, NY, 2000.

Academic Assistance Program "Smartthinking" is available to all FSU students; access through <http://blackboard.uncfsu.edu>. Mathematical software such Maple V and Mathematica are installed in FSU Computer Labs.

### \*VIII Course outline

Dates	Lectures
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THU: 08/19	[1.1] Introduction
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TUE: 08/24	[2.1] The difference operator
THU: 08/26	[2.2] Summation

TUE: 08/31	[2.2] Summation
THU: 09/02	[2.3] Generating Functions and approximate Summation

TUE: 09/07	<b>Exam #1</b>
THU: 09/09	[3.1] First order equations
	[3.2] General results for linear equations

TUE: 09/14	[3.3] Solving linear equations
THU: 09/16	[3.4] Applications

**\*VIII Course Outline with Assignment Schedule (continued)**


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TUE: 09/21 [3.5] Equations with variable coefficients  
 THU: 09/23 [3.6] Nonlinear equations that can be linearized

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TUE: 09/28 [3.7] The z-Transform  
 THU: 09/30 **Exam #2**

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TUE: 10/05 [4.1] Initial value problems for linear systems  
 THU: 10/07 [4.2] Stability of linear systems

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TUE: 10/12 [4.3] Phase plane analysis for linear systems  
 THU: 10/14 [4.4] Fundamental matrices and Floquet theory **(10/15-Midterm Break)**

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TUE: 10/19 [4.5] Stability of nonlinear systems  
 THU: 10/21 [4.6] Chaotic behavior

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TUE: 10/26 **Exam #3**  
 THU: 10/28 [5.1] Introduction  
 [5.2] asymptotic analysis of sums

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TUE: 11/02 [5.3] Linear equations  
 THU: 11/04 [5.4] Nonlinear equations

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TUE 11/09 [6.1] Introduction  
 [6.2] Sturmian Theory  
 THU: 11/11 Veteran's Day

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TUE: 11/16 **Exam #4**  
 THU: 11/18 [6.3] Green's functions  
 [6.4] Disconjugacy

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TUE: 11/23 [6.5] The Riccati equation  
 THU: 11/25 Thanksgiving Holiday

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TUE: 11/30 [6.6] Oscillation  
 THU: 12/02 Review for Final Exam

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\*\*\*\*\* **Final Exam**

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