Comprehensive Course Syllabus

Algebraic Structures I

Course Description:

The topic of this course is either Linear Algebra or Abstract Algebra. The majority of the time the topic will be linear algebra, the abstract option occurs in rare years when a large number of students took the linear option as juniors the year before and need another advanced course. **Spring 2018: Linear Algebra Option**

OPTION 1 (Linear Algebra)

This course concentrates on the theory of simultaneous linear equations. Gaussian elimination is used as a tool to solve linear systems and to investigate the subspace structure of a matrix (kernel, range, etc.) Extensions of these ideas include orthogonality and least squares. Determinants are examined from several perspectives. Eigenvalues and eigenvectors are introduced, including a discussion of special matrices (symmetric, unitary, normal, etc.). Applications may include singular value decomposition and the Fast Fourier transform.

INSTRUCTOR(S):

- Name(s): **Micah Fogel**

- Office Number(s) (When and where you are available for help.): **A157**
Daily 11AM – 1:15PM

- Telephone number(s): **x-5086**

- Email address(es): **fogel@imsa.edu**

Meeting Days, Time and Room(s)

Mod 3, ABCD days, A155

Text(s) / Materials:

(Linear option) Strang, Gilbert. *Introduction to Linear Algebra, 4th ed.* Wellesley-Cambridge Press. Wellesley, MA. 2015.

Essential Content:

- Solving systems of linear equations
  - Matrix algebra
  - Efficiency of methods
- Theory of general linear systems
  - Column, row, and nullspaces
  - Complete solution to general consistent system
- Orthogonality
  - Least squares and inconsistent systems
- Determinants
- Eigenvectors and diagonalization
- Special matrices (orthogonal, positive definite, etc.)
- Extended topics (FFT, Jordan form, etc.)

SSLs and Outcomes:
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Instructional Design and Approach:
This course is taught in the nature of a university-level mathematics course. Thus the bulk of class time is lecture. Frequent homework familiarizes students with the key ideas, but students are expected to do problems well in excess of those assigned if they expect to become thoroughly knowledgeable about the material. Such extra problems are suggested but not collected as homework. The idea is to get students used to the pattern of math instruction they will see as a math major at university: lecture, note-taking, reading ahead in the text, selecting one's own practice problems to become conversant with material.

Student Expectations:
This course is taught in the same manner as an upper division course at a university would be taught. Expectation of students will be the same as for university students: compelte solutions to problems, accurate use of terminology and notation, on-time submission of assignments, students take responsibility for learning. This is not a course for inexperienced students who need their hands held! Workload is high and expectation for mathematical advancement is high.

Assessment Practices, Procedures, and Processes:
There are approximately one-to-two homework assignments per week, consisting mostly of problem from the text which are to be completed with high expectations for mathematical rigor. There will be quizzes every few weeks. Students will never be asked to take a quiz on material for which they have not yet had homework returned and for which they had opportunity to ask questions. Every assignment lists required problems and recommended problems; students should complete many of the recommended problems if they expect to get the most out of the class.

Quarter grades are computed as: 2/3 quiz score, 1/3 homework score. The semester grade is 25% homework scores, 55% quiz scores, and 20% final exam.

Sequence of Topics and Activities

Linear option
Week 1: Vectors
Week 2: Matrices and solving systems by elimination
Week 3: Elimination and matrix factorization
Week 4-5: Vector spaces and subspaces; column and nullspaces of a matrix
Week 6-7: General systems, basis, dimension, fundamental subspaces
Week 8-9: Orthogonality, projections, Gram-Schmidt, least squares
Week 10-11: Determinants
Week 11-13: Eigenvalues, eigenvectors, diagonalization, applications
Week 14: Singular value decomposition
Week 15: Extensions to complex numbers
Week 16: Normal matrices
Week 17: Fast Fourier transform, general inner product spaces