Math 309 - Dr. Miller - Topics List for Exam #1, Spring 2018 - **Friday, Feb. 23, 2018**

Prepare for the exam by studying the listed tasks with reference to your notes, text, and graded and ungraded problems. Strive to master concepts and techniques for use in general; just memorizing familiar problems is unlikely to be successful. Many successful former students used Topics Lists to make their own fresh study guides that included solved examples and warnings. There are also old exams linked on my web site, but the material on them was organized and presented differently, so BEWARE!

**Systems of Equations and Their Representations:**

1. Convert between: system, augmented matrix, vector equation, and matrix equation notation.
2. Recognize, create systems or matrices that have/lack certain combinations of features. When asked, tell how we see those features in your examples.
   (a) Features include: consistent/inconsistent, number of variables vs. equations/rows vs. columns, homogeneous, no/one/infinitely many solutions, free/lead variables, specific solutions/solution sets, coefficient vs. augmented matrix, RREF/EF/neither, particular row/column entries.
   (b) Some creations or combinations of features may be impossible - prepare to explain why.
   (c) Systems must show EQUATIONS, but you may refer to matrices/properties when explaining.
   (d) Specifically address presence or lack of conflicts. (Warning: don't claim a system has infinitely many solutions due to a free variable, yet overlook a conflict, which dominates the situation.)
3. Solve given systems by hand or with technology as allowed. As asked, give solution lists or sets in correct notation (including set-builder for infinite sets, and empty set notation).
   (a) I may let you choose among back-substitution, inspection, or use of RREF to solve a system.
   (b) When required, perform row operations by hand and label them.
   (c) When by-hand is not needed, simply show your original matrix and your RREF, then continue.
4. Given an RREF augmented matrix, interpret what it tells about solutions to the related system.
5. Identify a given matrix as RREF, EF, neither.
6. As in text HW, show forms (I'll give a legend) for RREF or EF matrices of given sizes.

**Linear Combinations, Related Concepts:**

1. You must choose whether a task needs just technology, or requires by-hand row-reduction.
2. Use the phrase "linear combination" to explain informally what it means for one vector to belong to the span of others, for a set to span $\mathbf{R}^n$.
3. Use the phrase "linear combination" to explain informally what it means for a set of vectors to be linearly independent, to be linearly dependent.
4. Given a set of vectors, determine whether a specific other belongs to their span or not. Justify.
5. Tell whether a given set of vectors spans a particular $\mathbf{R}^n$. Justify.
6. Write a vector as a linear combination of others, if possible. If not, explain what goes wrong.
7. Be aware of when you can write the same vector as more than one linear combination, and do so.
8. State the FORMAL definition (full sentence, including hypotheses) of "linearly independent."
9. Determine whether a given set of vectors is dependent or independent. Justify/explain.
   (a) Use of matrices or simple inspection is allowed (including Thm 9).
   (b) You may also use size considerations (Theorem 8) and other short-cuts.
10. Find the relationship necessary on coordinates of an arbitrary vector to force it to belong to the span of certain others (as in #17 p.33 or #16 p.41). (Row reduce by hand.)
11. Given an RREF coefficient matrix, interpret what it says about spanning $\mathbf{R}^n$ or independence, as in class.

Technology: You may use ONLY the MathDetails and Dangries online applets during the exam, and the computer's built-in calculator (not your own).

**"Explain" always means USE WORDS!**
("Justify" does not.)