Review for MAS2103 Exam # 1 Fall 2013

(1) Definitions:
  (a) Sets, Cartesian Products
  (b) Relations: symmetric, transitive, reflexive
  (c) functions: injective (-1), surjective (onto), bijective
  (d) (binary) operations: $* : S \times S \to S$.
  (e) (binary) operations: associative, commutative, identity, inverses
  (f) scalar product: $(\cdot)$: $\mathbb{F} \times V \to V$.
  (g) groups, rings, fields, $\mathbb{F}$-vector spaces
  (h) matrix $m \times n$: rows $\times$ columns
  (i) square matrices
  (j) rings of matrices $M_{m\times n}(\mathbb{F})$, $M_n(\mathbb{F})$
  (k) matrix multiplication
  (l) transpose of a matric and properties: $(A+B)^t = A^t + B^t$, $(AB)^t = B^t A^t$.
  (m) subspaces: nonempty such that $\forall \vec{v}_1, \vec{v}_2 \in W$ and $\forall \alpha \in \mathbb{F}$, $\vec{v}_1 + \vec{v}_2 \in W$ and $\alpha \vec{v}_1 \in W$.
  (n) span of a set of vectors: $\text{Span}(v_1, \ldots, v_k) = \{\alpha_1 \vec{v}_1 + \ldots \alpha_k \vec{v}_k | \alpha_1, \ldots, \alpha_k \in \mathbb{F}\}$.
  (o) linear transformation $S : V \to W$: $S(\vec{v}_1 + \vec{v}_2) = S(\vec{v}_1) + S(\vec{v}_2)$, $S(\alpha \vec{v}) = \alpha S(\vec{v})$ $\forall \vec{v}_1, \vec{v}_2 \in W$ and $\forall \alpha \in \mathbb{F}$.
  (p) Given a $m \times n$ matrix A: then $T_A : \mathbb{F}^n \to \mathbb{F}^m$ defined by $T_A((x_1, \ldots, x_n)) = A \cdot (x_1, \ldots, x_k)^t$ is a linear transformation.
  (q) matrix representation of a linear transformation: If $S : \mathbb{F}^n \to \mathbb{F}^m$ is linear, then you find A such that $T_A = S$.
  (r) homogeneous equation: $S(\vec{x}) = \vec{0}$.
  (s) (nul space) Kernel of a linear transformation $S : V \to W$: $\text{nul}(S) = \{\vec{v} \in V : S(\vec{v} = \vec{0}\}$
  (t) Row Echelon Form; Reduced Echelon Form: http://en.wikipedia.org/wiki/Echelon form
  (u) $\mathbb{Z}_5$ as a field.

(2) Examples of $\mathbb{F}$-Vector Spaces: $\mathbb{F}^n$, $M_{m\times n}$, $C([0,1])$, $C'([0,1])$

(3) Solve a system of equations using Gaussian Elimination.

(4) Work on similar problems over $\mathbb{R}$ or $\mathbb{Z}_5$.

(5) Examples of subspaces: nul space, the range of a linear transformation, the intersection of two subspaces.

(6) Systems of equations, matrix equation, linear transformation equation

(7) Prove whether a given function is a linear transformation or show that it is not.

(8) Prove a set is a subspace or determine it is not.

From LADW: Chapter 1:
§1. 1-6
§3. 1-4
§5. 1, 3, 7
§7. 1-4