STUDY GUIDE FOR TEST 3 OF MTH 310

Test 3 is scheduled for Wednesday, December 7. It will cover sections I, II, III, and IV.1–3 of Chapter 3 from your book. This material is on pages 137–228.

Be able to define the following terms.
1. isomorphism
2. isomorphic vector spaces
3. homomorphism (or linear map)
4. rangespace of a homomorphism
5. nullspace of a homomorphism
6. rank of a homomorphism
7. nullity of a homomorphism
8. nonsingular homomorphism
9. identity matrix
10. diagonal matrix

Be familiar with the following theorems.
1. I.1.8,9
2. I.2.1,2
3. II.1.7,9
4. II.2.1,10,14,18,21
5. III.1.4
6. III.2.1,3,5,6
7. IV.1.5
8. IV.2.6,12
9. IV.3.19,22

The following is a list of things you should know and be able to do for the test. It is not necessarily complete.
1. Determine whether a function is an isomorphism.
2. Know how the dimensions of vector spaces are related to whether they are isomorphic. Use this to determine whether vector spaces are isomorphic, or to determine the dimension of a vector space.
3. Determine whether a function is linear (a homomorphism).
4. Use information about the action of a linear map $f$ on a basis for a vector space to find $f(\alpha)$ for any $\alpha$.
5. Find the rangespace of a linear map.
6. Find the nullspace of a linear map.
7. Determine the rank of a linear map from the rangespace.
8. Determine the nullity of a linear map from the nullspace.
9. Know the connection between the nullity and rank of a linear map, and the dimension of the domain of the map, and use this connection to find one or more of these values.
10. Know and apply the connection between nullity, rank, and nonsingularity of a linear map.
11. Construct a matrix that represents a linear map.
12. Use the matrix representing a linear map to evaluate $f(\alpha)$. 
13. Use the matrix representing a linear map to determine the nullity and rank of the map, and to find the rangespace and nullspace of the map.

14. Perform basic arithmetic operations with matrices or determine that the operations are not defined.

15. Use matrix operations to find a matrix that represents a combination of linear maps.

16. Use the matrix representation of a linear map to determine whether the map is nonsingular.

17. Prove simple facts about these concepts.