MATHEMATICS 5101: Mathematical Principles in Science I

Tentative Lectures and Reading Assignments

Vector Spaces

1. Why linearity? Why Vector Spaces? Definition and examples [J&R 4.2; St 2.1];

2. Subspaces,subspace theorem [J& R 4.3; St 2.1];

3. Spanning set, span as a subspace, linear (in)dependence [J & R 4.4]

4. basis, coordinates relative to a given or chosen basis: its usefulness [J& R 4.4; St 2.3]; Isomorphic linear combinations; computational usefulness; uniquenes $\Leftrightarrow$ linear independence $\Leftrightarrow$ one to one; existence $\Leftrightarrow$ spanning property $\Leftrightarrow$ onto.

5. Dimension of a vector space; criteria for a set of vectors to be a basis for a finite dimensional vector space [J&R 4.5]. Linear functionals. Dual of a vector space [J&R 4.5; FIS 2.6]

6. Bracket notation; construction of linear function(al)s; dual basis; coordinate surfaces vs. coordinate lines; interpolation of sampled data [handout]

7. Metric (inner product) on a vector space; [J&R 4.6] metric as a map between vectors and covectors; reciprocal basis.

8. Review of reciprocal basis; linear tranformation; onto maps; one-to-one maps; [J&R R 4.7] null space $\subset$ domain space; range space $\subset$ target space

PRIMARY RECOURCE TEXTS FOR MATH 601

J& R: 1. L.W. Johnson & R.D. Riess, "Introduction to Linear Algebra" (primarily chapter 4), Third Edition;
Nota bene: The concepts and ideas developed in this chapter are timeless. Consequently, it matters little whether you have the 2nd, the 3rd, or the 4th edition. However, the 1st edition is pretty worthless by comparison.

St: 2. G. Strang, "Linear Algebra and Its Applications", Third Edition.

SECONDARY RECOURCE TEXTS FOR MATH 601

MTW: 3. C.W. Misner, K.S. Thorne, and J.A.Wheeler, "Gravitation"

FIS: 4. S.H. Friedberg, A.J. Insel, L.E. Spence, "Linear Algebra"