Production, Industrial Organization and Regulation:
Part a: Mathematical Foundations
Syllabus

SB refers to Mathematics for Economists, by Carl Simon and Larry Blume (SB). F refers to Mathematical Methods and Models for Economists, by Angel De La Fuente MWG refers to Mathematical Appendix to Microeconomic Theory, by Mas-Colell, Whinston and Green (MWG). The texts are only peripherally related to the course material. The chapter guides are approximate.

(1) **Linear Algebra**

(a) Linear Combinations, Linear Independence, Linear Dependence and Cones.
(b) Vector Spaces
(c) Spanning, Dimension, Basis
(d) Matrices and Rank
(e) Linear Functions
(f) The “graph” of a linear function from $\mathbb{R}^2$ to $\mathbb{R}^2$
(g) Determinants, Rank and volume
(h) Solving linear equation systems and Cramer’s Rule
(i) Eigenvalues and eigenvectors

(2) **Calculus**

(a) The fundamental notion: linear approximations to nonlinear functions.
(b) Partial Derivative, Cross Partial and Total Derivatives
(c) The differential in Multivariate Calculus: real-valued functions
(d) The differential in Multivariate Calculus: vector-valued functions
(e) Taylor’s Theorem
(f) Application of Taylor’s theorem: 2nd order conditions for an unconstrained maximum

(3) **Constrained Optimization**

(a) Existence and Uniqueness
(b) Necessary and sufficient conditions for a solution to an NPP
(c) Demonstration of why the KT conditions are really necessary
(d) Interpretation of the Lagrange Multiplier
(e) KT conditions and the Lagrangian approach
(f) Computing a solution to a NPP: a worked example
(g) Second Order conditions for a Constrained Maximum

(4) **Comparative Statics**

(a) The envelope theorem (unconstrained version).
(b) The envelope theorem (constrained version).
(c) Implicit function theorem
(d) The implicit function theorem and comparative statics.