

SYLLABUS COURSE 002
Introductory Mathematical Economics
MA Economics Summer Semester 2012
DELHI SCHOOL OF ECONOMICS

Objectives: This is essentially a tool course that frequently feeds into Microeconomics, Macroeconomics and Econometrics.

Instructors: Two instructors will cover the entire syllabus.

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- Sugata Bag [SB], (Contact: 27666533/4/5 Extn:115), email: sugata@econdse.org

Time and Location: Room # Lecture Theatre.

Lecture Hours: 10.25-11.35 AM on Mondays, Wednesdays and Fridays

Prerequisites: Mathematical content at the level of *Sydsaeter and Hammond*, the undergraduate *Mathematics for Economics* textbook in the University of Delhi.

Description: There are 3 parts to the course.

1. Preliminaries (e.g. Logic, Set Theory, Functions); Linear Algebra. [SB]
2. Multivariate Differentiation, Implicit Function Theorem, Optimization in \mathfrak{R}^n ; Envelope Theorem; Differential Equations [AB]
3. Dynamic Optimization. [SB]

Textbooks:

- Treil, Sergei . 2010. *Linear Algebra Done Wrong*. (**LADW**) [ebook available at www.math.brown.edu/~treil/papers/LADW/LADW_intro.pdf]
- Strang, Gilbert. 2003. *Linear Algebra And It's Application*, (3rd Ed). (**GS**)
- Simmons, G. F.1963. *Introduction to Topology & Modern Analysis*. (**S1**)
- Sundaram, Rangarajan. 1996. *A First Course in Optimization Theory*. CUP. (**RS**)
- Simon and Blume. 1994. *Mathematics for Economists*. Norton & Co. (**SB**)
- Simmons, George F. *Differential Equations*. (2nd Ed) (**S2**)
- Dixit, Avinash. 1990. *Optimization in Economic Theory* (2nd Ed.).
- Chiang, Alpha C. 1999. *Elements of Dynamic Optimization*. (**AC**)

TOPICS in Part 1: (SB)

1. *Preliminaries*: Logical Implications, Sets, Relations, Functions etc. [Ref: S - ch.1, RS - Appendix A].
2. Linear Algebra. Basic concepts (e.g. linear spaces, linear combinations, subspaces, basis, dimension, linear transformation, Fundamental theorem of linear algebra). Systems of linear equations. Spectral Theory. Inner Product Spaces (mainly Orthogonal Projections). Quadratic Forms. [Ref: - LADW, GS].

Material:

We shall use chapter 1 of S and Appendix A of RS for preliminary stuff. While we won't use chapter 1 of RS, that chapter covers very nicely but tersely a lot of the material that is considered a prerequisite for Optimization.

For Linear Algebra, we shall use stuff from both LADW & GS, but not exclusively from these two. While it is difficult to pinpoint the source of every proof for every result, alternative textbooks include those by Helson, and the classic by Halmos. Ordinarily, it is best to study from a single textbook, besides following and working through the lectures.

Note. *Simon and Blume* is a useful book covering most of the material in the course (all 3 parts), save for Dynamic Optimization. While it is not the main reference for the above topics, it is a reasonable alternative reference. Moreover, if you haven't read *Sydsaeter and Hammond* seriously, it may be a good idea to cover most of Simon and Blume (on your own) alongside this course.

TOPICS in Part 2: (AB)

1. Standard applications of Optimization; Weierstrass' Theorem; Unconstrained Optimization; Optimization with (i) Equality Constraints (ii) Inequality Constraints; Envelope Theorem. Readings: RS Chapters 2-6.
2. Differential Equations. Ordinary first order differential equations, systems of differential equations (in particular, systems of 2 differential equations), Stability. Material sourced from 3 chapters of S2.

Topics in Part 3: (SB)

1. Dynamic Optimization: Introduction to DO, Optimal Control Theory - Pontryagin Maximum Principle, Finite and Infinite Horizon Problems. Text: AC, chapters 1, 7-9.

Exams: There will be 2 midterm and one Endterm exams. Midterms will happen in mid September and end October, the final end term is scheduled for end of November.

Grading: There will be two midterm exams and a final. They will count toward the grade as follows.

Midterm 1	15 percent
Midterm 2	15 percent
Final	70 percent

Instructions for Students: A course webpage is maintained for 002 (<http://econ.dse.org/course-002/>), which will be used round the year to communicate all the materials (e.g. lecture slides, notes, handout, assignments etc.) to you.