École Polytechnique Fédérale de Lausanne
College of Management of Technology

SYLLABUS
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MGT 626 – Concepts in Operations, Economics and Strategy

Spring 2014

February 17/19/21/24/26/28, March 10: 13-17h
ODY -1.0019.1

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Course Website

http://econspace.net/MGT-626.html

Summary. The viability of a firm is determined in a critical way by its actions. To find actions that help guarantee its survival and satisfy stakeholder interests, the firm devises a *strategy* (i.e., a dynamic plan), taking into account competitors' *economics* and its own capabilities in the form of its current or anticipated *operations*. This course is concerned with fundamental concepts at the intersection of operations, economics and strategy, in order to enable the student to engage in model-based research explaining or guiding a firm's decisions in a competitive environment.

This year, the course provides an overview of classical and nonclassical optimal control applications in operations and economics. The approach is hierarchical. First we discuss single-person decision problems in which a firm or a social planner maximizes an objective function subject to certain constraints. Applications include dynamic pricing, investment, marketing, and the harvesting of renewable resources. Second we introduce games in which several decision makers interact, either in a leader-follower (Stackelberg) setting or in a situation where all players reach their decisions simultaneously. Applications include dynamic oligopolies with open and closed-loop equilibria and capital accumulation games, and the dynamic pricing with a strategic buyer. In the third part of the course, we look at problems, which involve the design of economic mechanisms, applied to screening and optimal auctions. The course uses tools

in the economics of uncertainty and information, operations, and fundamental management concepts to teach fundamentals and construct pointers to the frontier of applied research. The goal is to develop an understanding of how a firm can derive a competitive advantage from its operations using economic analysis as much as possible, rather than qualitative arguments.

Required Text. There is no required textbook for this course. Current required and background readings will be posted on the course website.

Assessment. Students need to complete a number of homework assignments (problem sets). There will be a final exam as well as a team project.

The final examination covers the whole of the course. The course grade is computed as follows:

Grade = 0.2 (Problem Sets) + 0.4 (Exam) + 0.3 (Project) + 0.1 (Participation).

For all *problem sets* I strongly encourage cooperation. Since some of the analysis can be demanding in terms of the new intuition required, discussing the problems with others is very important. Solutions need to be written up and handed in individually.

Course Website. Go to http://econspace.net/MGT-626.html and log in using the username and password provided in class.

For all *problem sets* I strongly encourage cooperation. Since the questions are designed to be both interesting and challenging, discussing them with others is essential for mastering the concepts. Note that solutions need to be written up and handed in individually (see also the sections on *Homework* and *Honor Code* below).

- **Problem Sets.** Homework will be assigned about other week in the form of a problem set. Homework is due at the beginning of class on its due date. **No late homework will be accepted and there is no makeup homework!** Graded homework assignments will be returned in class.

- **Exams.** There will be a *final exam* on March 10, in class. The exam is open-book. **There is no makeup exam!** If you have a justified scheduling conflict, you will have to make an arrangement with the teaching staff before March 1. Any requests made after that day (other than documented emergencies) may or may not be granted.

- **Class Participation.** Your presence and participation in class are essential for gaining mastery of the material.

- **Project.** The project is an integral part of the course and complements the course material. Each student should submit a report of at most 10 pages (excluding the references), providing the outline of a continuous-time optimal control problem in the context of operations, economics, and/or strategy. The problem should present an interesting real-world application. An introduction should outline how this application may fit into the current literature. Although there is no need to explicitly solve the problem, the student should state the problem exactly and attempt to provide a preliminary analysis. Lastly, the student should provide an extension of the problem which would make it a nonstandard optimal control

problem. If the problem is already in a nonstandard form, the student should explain why. A one-page proposal for the project is due in Session 6, with the instructor's feedback to be provided in Session 7. The final version of the project is due 4 weeks after the end of the course, on <u>Monday</u>, <u>April 7</u>, <u>before 5 pm</u>, by email to the instructor.

Honor Code.[1] The Honor Code is the EPFL's statement on academic integrity. It articulates the school's expectations of students and faculty in establishing and maintaining the highest standards in academic work:[2]

"EPFL has the mission of generating, sharing and utilizing knowledge. It encourages development of the critical sense and spirit of innovation in a climate of collaboration, respect and mutual confidence among all its members.
- o *Favor constructive dialogue at EPFL, particularly via active involvement in the various EPFL consultative and participative bodies.*
- o *Approach faculty-student interactions with a positive attitude.*
- o *Strengthen relations between colleagues in a spirit of friendship, support and*
- o *collaboration.*

I assume the ethical responsibilities and duties of academic and professional training by:
- o *Acknowledging and respecting the value of the titles conferred by EPFL.*
- o *Refusing to indulge in cheating.*
- o *Refusing to indulge in plagiarism. I undertake to cite and clearly reference all sources of aid or information.*
- o *Respecting all members of the EPFL community and the work they accomplish.*
- o *Respecting the institution's infrastructures and its environment.*
- o *Using resources provided by EPFL, particularly IT facilities, in an appropriate fashion.*

Through my actions and commitment to this Honor Code, I contribute to the impact and reputation of EPFL and thus enhance the value of my diploma."

Specifically, adhering to the EPFL Honor Code implies that all work in exams and quizzes must be done individually. For homework, students may consult with the teaching assistant and with other students, but must write up solutions independently based on their own understanding. <u>All</u> references and sources (e.g., in the team project) must be clearly identified and properly referenced. Lastly, *if you work with other students on a problem set, you must acknowledge their names on the front page of your submission.*

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[1] For more information, see http://jahia-prod.epfl.ch/site/polylex/ethics
[2] http://polylex.epfl.ch/files/content/sites/polylex/files/recueil_pdf/ENG/2.3.1_ch_code_honor_en.pdf

Topics. Following is a tentative schedule of topics for this semester.

Tentative Schedule

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I.   <u>**Fundamentals: Models**</u>

<u>**Session 1**</u> **(February 17): Description of Dynamic Systems**

<u>**Session 2**</u> **(February 19): Stability Properties**

II.   <u>**Optimization: Dynamic Decisions**</u>

<u>**Session 3**</u> **(February 21): Control Systems**

   Due: Problem Set 1

<u>**Session 4**</u> **(February 24): Optimal Control**

III.   <u>**Interaction: Dynamic Games & Design of Mechanisms**</u>

<u>**Session 5**</u> **(February 26): Dynamic Games**

   Due: Problem Set 2

<u>**Session 6**</u> **(February 28): Mechanism Design**

   Due: Project Proposal

<u>**Session 7**</u> **(March 10): Putting the Tools to Work: Applications; Final Exam**

   Due: Problem Set 3 [<u>Due on **March 7**, before 5 pm</u>, when solutions are posted]

<u>**Projects are due on Monday, April 7, at 5 pm, by email**</u>

Reading. The material in this course is largely contained in the following book. The references therein point to additional literature on the subject.

WEBER, T.A. (2011). *Optimal Control Theory with Applications in Economics*, MIT Press, Cambridge, MA.