EG2050
SYSTEM PLANNING

INTRODUCTION

Spring 2014

KTH Electrical Engineering

BACKGROUND

- Challenges for the power system:
  - Economic efficiency
  - Reliability
  - Environmental impact
- In order to deal with these issues, it is important to understand how a power system is operated.
- This course introduces basic operational procedures and planning tools for power systems.

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GENERAL SYSTEM PLANNING

This course considers electric power systems; however, there are similarities to planning of other technical systems.

Table 1.1 Comparison of the planning for different systems

System	Regulation	Operation	Planning	Investments
Aviation	technical function of aircraft and ground control	emergency plans, keeping schedules, economical flying	air routes, maintenance, pricing	new aircraft
Papermill	machine function	economical operation, varying raw material, optimal quality	submitting offers, pricing, maintenance	new machines
Office	the individual task of each co-worker	coordination, deadlines	submitting offers, estimating costs, education	new staff, new equipment, new premises
Power system	primary control, secondary control	coordination of power plants, economical operation	pricing, maintenance	new power plants, grid expansion, long-term contracts
	seconds technology security	→		years economy uncertainty

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ELECTRICITY MARKETS

Course Objectives

- To pass: Describe the principles of how an electricity market can be organised.

Learning Activities

- Lecture 1–2 and lecture assignments.

Exam

- To pass: Problem 1.

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ELECTRICITY PRICING

Course Objectives

- To pass: Perform rough estimations of electricity prices.
- Higher grade: Identify factors that have a large importance for the electricity pricing, and indicate how these factors affect for example producers and consumers.

Learning Activities

- Lecture 3–4 and lecture assignments.
- Home assignments part I.

Exam

- To pass: Problem 2.
- Higher grade: Problem 6.

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FREQUENCY CONTROL

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Course Objectives

- To pass: Explain how the balance between production and consumption is maintained in an electric power system, and calculate how the frequency is affected by various events in the power system.
- Higher grade: Determine if the frequency control of an electric power system has sufficient margins, and if necessary be able to choose between various measures to increase the margins.

Learning Activities

- Lectures 5–6 and lecture assignments.
- Home assignments part II.

Exam

- To pass: Problem 3.
- Higher grade: Problem 7.

SHORT-TERM PLANNING

Course Objectives

- To pass: Formulate short-term planning problems of hydro-thermal power systems.
- Higher grade: Create specialised models for short-term planning problems.

Learning Activities

- Lectures 7–10 and lecture assignments.
- Home assignments part III.

Exam

- To pass: Problem 4.
- Higher grade: Problem 8.

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SIMULATION OF ELECTRICITY MARKETS

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Course Objectives

- To pass: Apply both probabilistic production cost simulation and Monte Carlo simulation to calculate expected operation cost and risk of power deficit in an electricity market.
- Higher grade: Create specialised models both for probabilistic production cost simulation and Monte Carlo simulation, and use the results of an electricity market simulation to judge the consequences of various actions in the electricity market.

SIMULATION OF ELECTRICITY MARKETS

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Learning Activities

- Lectures 11–18 and lecture assignments.
- Home assignments part IV.

Exam

- To pass: Problem 5.
- Higher grade: Problem 9.

EXAMINATION

- Laboratory course (0.5 hp)
- Written exam (7.0 hp)
  - The laboratory course should be completed before you write the exam.
  - Students who passed the old laboratory course (which consisted of a computer assignment) will not have to do the new laboratory course.

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EXAMINATION - Laboratory course

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- Comprises selected home assignment problems with a total score of 50 lab points.
- 45 lab points are required to pass the laboratory course.
- Lab points are acquired by preparing oral presentations to be given at the home assignment seminars.

EXAMINATION - Laboratory course

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- At the beginning of each seminar, all participating students state which problems they are prepared to present.
- The students should also hand in a copy of their presentation.
- In the ordinary seminars, one student per problem will be selected to give the presentation.
- In the repetition occasions, each student will present one or more problems.

EXAMINATION - Laboratory course

- If a student has passed all presentations during a seminar (or if the student is not selected to present) then lab points will be rewarded for all assignment that the student has prepared.
- However, if a student fails at least one oral presentation, no lab points at all will be rewarded for this seminar, regardless of which other assignments that the student have been prepared to present!

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EXAMINATION - Laboratory course

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Requirements to pass a presentation:

- Explanation of how the problem was solved. and the obtained results.
- Ability to explain all details in the calculations when receiving questions from other students or the teaching assistant.
- Ability to discuss alternative solution methods.

Please notice that a completely correct solution is not necessary to pass a presentation!

EXAMINATION - Written exam

The following aids are allowed during the exam:

- Calculator without information relevant to the course.
- One hand-written, single-sided A4-page with your own notes (original, not a copy). This page should be handed in together with the exam.

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EXAMINATION - Written exam

The exam is divided in two parts.

- In the first part you show that you master the basic requirements to pass the course.
- In the second part you show that you master the requirements for obtaining a higher grade (A–D).
- The second part will only be marked if the student passed the first part!

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EXAMINATION - Written exam

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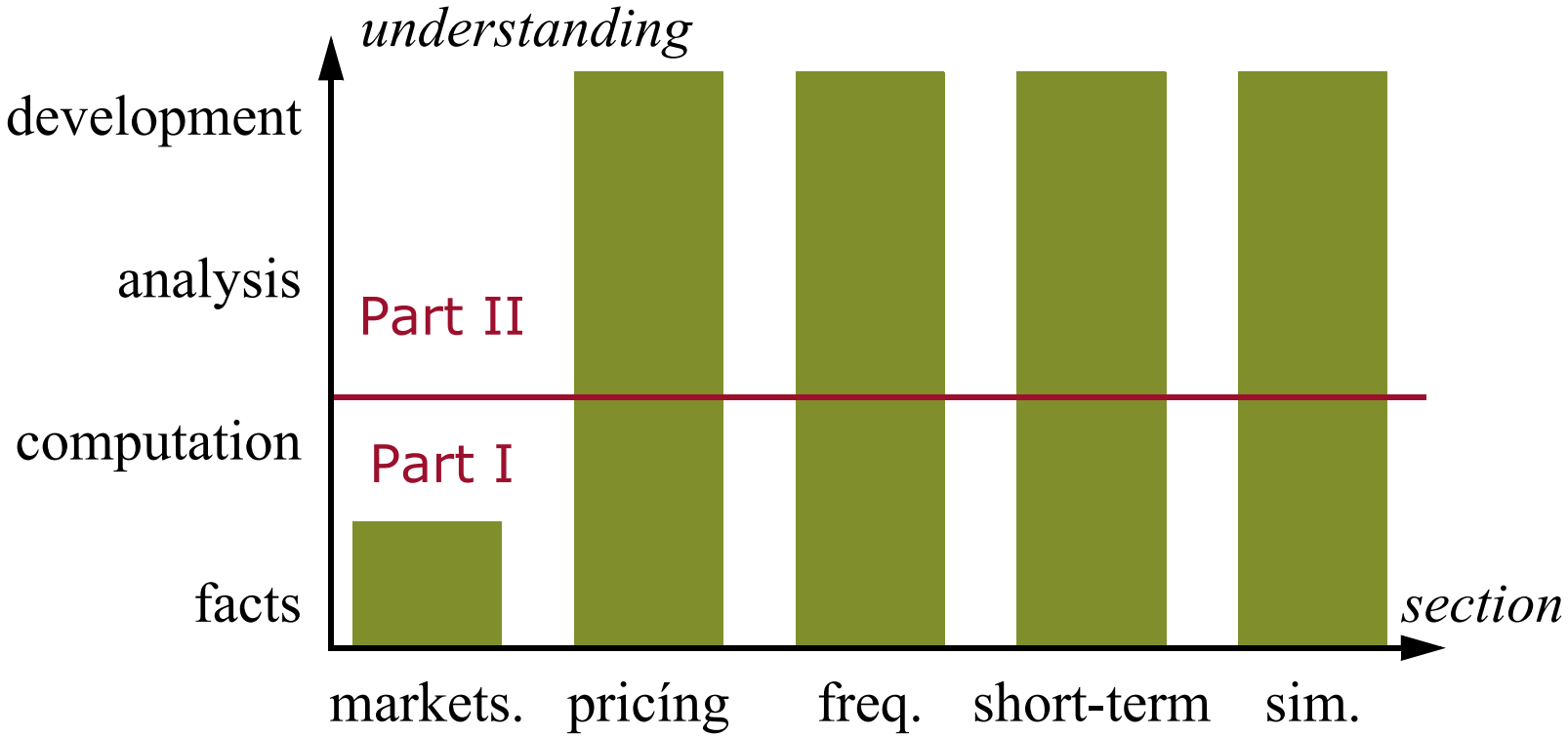

EXAMINATION - Written exam

Part I

- Short questions – short answers.
  Explaining your calculations is optional.
- Some familiar problems and usually at least one new problem!

Part II

- Complex problems – read a quite long text, identify the problem and choose an appropriate solution method.
  Important to motivate all expressions, so that the argument and calculations can be easily followed!

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EXAMINATION - Written exam

- Important to double-check your answers in part I!
- Negligence is not acceptable for the basic problems!
  - The NASA space probe Mars Climate Orbiter was destroyed when entering orbit around Mars in September 1999.
  - The reason for the failure was that the flight system software was expecting instructions in metric units, whereas the software used by the ground crew generated instructions in Imperial units. (1 N ≈ 0.22481 lb_F)

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EXAMINATION
- Home assignments

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- Some home assignments reward bonus points for the exam.
- These home assignments are presented in written reports.
- The bonus points are valid for the exams in March and June this year.
- Reports must include sufficient detail that the argument and calculations can be easily followed.

EXAMINATION
- Home assignments

- KTH defines plagiarism as "submitting someone else's work as your own".
  This includes text, program code, tables and figures!
- Will be considered as a "learning error" (no bonus points) if there is no reason to suspect an attempt to deceive.
- Otherwise, the case will be reported to the President of KTH and might be examined in the Disciplinary Board.

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EXAMINATION - Partial exams

- Three one-hour partial exams are scheduled.
- Same rules as for exams:
  - Sign-up using KTH My pages.
  - Students must arrive within 45 minutes.
  - No-one may leave the room until the end of the partial exam.
- Student who receive at least 33 points in the partial exams can skip part I of the exam.
  - Students who passed the partial exam may rewrite part I of the exam to improve their score.
- Results from the partial exams are valid for the exams in March and June respectively.

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EXAMINATION - Grading

Score from part I	Total score (part I + part II + bonus)	Grade
0–30	–	F
31–32	–	Fx
33–40	33–59	E
33–40	60–69	D
33–40	70–79	C
33–40	80–89	B
33–40	90–115	A

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PRACTICAL INFORMATION

Course web pages

www.kth.se/social/course/EG2050

Language

- Lectures are given in English.
- Compendium, assignments and exams are available in English and Swedish.
- Home assignments seminars are available in English and Swedish.

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PRACTICAL INFORMATION

Course registration

- Registration into the national study administration system (Ladok) is done using KTH My Pages.

  Only first-time students. Reregistration is done by the Student office.

- We need to have an internal register of student results. Therefore, all active students must fill out a registration form. Go to the course webb page, choose Course registration in the menu to the right and follow the link.

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PRACTICAL INFORMATION

Literature

- Course compendium (200 SEK, sold by the student office)
- Lecture notes (course web page)
- Old exams (course web page)

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PRACTICAL INFORMATION

Course mail box

Address: Teknikringen 33, entrance hall, 1st floor

Student office

Address: STEX, Osquldas väg 10

Open Monday–Friday 9:30–11:00, 12:00–14:00

Student room

Address: Teknikringen 33, room 2412

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COURSE DEVELOPMENT

- Last round of EG2050 System Planning given academic year 2013/14.
- From the academic year 2014/15 there will be two new courses.
  - EG2200 Power Generation Operation and Planning, 6 credits (period 1–2)
  - EG2205 Power Generation Operation and Planning, 7.5 credits (period 3)
- Project assignments equivalent to the EG2050 laboratory course will be given in EG2205.
- Exams in EG2050 will be given twice a year until June 2017.

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COURSE DEVELOPMENT

- Let us know what you think of the course!
  - E-mail
  - Comment fields on course web page
  - Questionnaire during exam
- We need a few students for a course evaluation committee.
  - Preferably at least one student from electrical engineering, industrial economics and exchange programmes, respectively.
  - Meeting during lunch at Syster och bror (KTH pays for lunch).

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