



Intensive Courses on Electric Networks

The Supergen Flexnet Consortium will be running three training courses, on **Fundamentals of Power System Engineering and Economics**, **Social and Psychological Aspects of Electricity Networks** and on **Electricity Economics**. Each course is designed to familiarise participants with the approaches and techniques used by one of the three disciplines in the consortium. Attendees should have a background in some aspect of electricity, but no discipline-specific knowledge will be assumed at the start of the courses.

Fundamentals of Power System Engineering and Economics

Professor Janusz Bialek, Durham University, probably in late June or July 2010

The aim of this simulation-based course is to investigate technical and economic problems created by transmission and distribution of energy from power stations to consumers. Teaching will be based around the PowerWorld load-flow simulation program. After some introductory lectures covering fundamentals of electrical engineering and electricity markets, students will be investigating the problems of voltage drops, reactive power compensation, transmission constraints, steady-state stability, and transmission losses. Then PowerWorld will be used to evaluate how network effects can be incorporated in an electricity market by means of Locational Marginal Pricing.

Social and psychological aspects of electricity networks

Professor Patrick Devine-Wright, University of Exeter, 13-16 September 2010

This short course aims to provide students with a basic introduction to social and psychological aspects of electricity networks, covering theoretical and methodological aspects. Key themes include: ways of thinking about publics in relation to electricity supply (i.e. as energy consumers, users or citizens); public understanding of how networks operate and who operates them; beliefs about blackouts, their impacts, likelihood and causes; smartgrids; and public acceptance of network change. Case studies will be presented of public beliefs about the use of hydrogen in the Shetland Islands to store wind-generated electricity, and aspects of the process of public engagement around new powerlines for nuclear power Hinkley Point, Somerset. Finally, a basic introduction to social research methods will be provided, covering issues such as ethics, qualitative and quantitative methods.

Electricity Economics

Professor Richard Green, University of Birmingham, 19-22 April 2010

This course will provide students with an introduction to the key aspects of economics relevant to the electricity industry. Key themes will include the relationship between costs and market prices, methods of regulating monopolies, and the desirable level of investment. Ways of internalising environmental effects, such as carbon emissions, will be at length during the course.

Supergen Flexnet consists of researchers from eleven UK universities (Bath, Birmingham, Cambridge, Cardiff, Durham, Edinburgh, Exeter, Imperial College, Manchester, Strathclyde and Surrey) with support from the Engineering and Physical Sciences Research Council and our industrial partners (EDF Energy, The National Grid Company plc, Rolls-Royce plc, Scottish Power, Scottish and Southern Energy plc, CE Electric and Central Networks). FlexNet's intention is to put in place a substantial body of work that will build on our past achievements and lay out the major steps, technical, economic, market design, public acceptance and others, that will lead to flexible networks. We will start to showcase these so that they can be taken up by the commercial sector, Government and Regulators for practical implementation.

These courses are available to participants from outside the consortium, and from the public and private sectors (subject to numbers). Consortium members will be charged for accommodation (if required); other participants from the UK Academic sector will be charged £250 per course, and others will be charged £500 per course.

Please send enquiries to r.j.green@bham.ac.uk



Intensive Course in Power System Engineering

Fundamentals of Power System Engineering and Economics

Professor Janusz Bialek, Durham University, probably in late June or July 2010

Aims & Objectives

The aims of the course are:

- To provide a hands-on experience of technical problems created by transmission and distribution of energy from power stations to consumers.
- To see how optimal system operation can be obtained in an electricity market with locational marginal prices

The course is simulation-based utilising the PowerWorld load-flow simulation program. After some introductory lectures, the students will be investigating the problems of voltage drops, thermal transmission constraints, steady-state stability constraints, and transmission losses. In the second part of the course the students will be introduced to the principles of power system economics. The PowerWorld program will be used to evaluate network effects in electricity pricing, using the locational marginal pricing common in US electricity markets.

Learning Outcomes

Ability to use a load flow package.

Understanding and modelling of AC network effects of transmission and distribution of electricity.

Understanding of how energy is priced and how network affects marginal prices at different locations.

Understanding of how strategic bidding can influence the market outcome.

Syllabus

1. Power system fundamentals. Circuit theory. Transmission effects of real and reactive power.
2. Theory of load flow analysis
3. Simulation exercise 1: Simple load flow.
4. Simulation exercise 2: Constraints, reactive power compensation, cost minimisation.
5. Theory of Optimal Power Flow (OPF)
6. Simulation exercise 3: Economic Dispatch and OPF, security-constrained OPF
7. Spot pricing of electricity. Transmission networks and locational marginal pricing.
8. Simulation exercise 4: Locational Marginal Pricing, bidding and gaming.

Textbooks

J D Glover, M S Sarma: "Power System Analysis and Design", Third edition, Brooks/Cole, Thomson Learning, 2002.

D S Kirschen, G Strbac: "Fundamentals of Power System Economics" J. Wiley, 2004

Additional/alternative reading:

B M Weedy, B J Cory: "Electric Power Systems", Fourth Edition, J. Wiley, 1998

S Stoft "Power System Economics" Wiley-Interscience, 2002

Course Assessment

Short report on each theoretical problem and simulation exercise

The course will be held at the University of Durham. Bed and breakfast accommodation will be available for participants, through kate.horner@durham.ac.uk once the dates are confirmed

For further details, contact Janusz.Bialek@durham.ac.uk

To register, contact r.j.green@bham.ac.uk



Intensive Course in Electricity Networks

Social and psychological aspects of electricity networks

Professor Patrick Devine-Wright, University of Exeter, 13-16 September 2010

This short course aims to provide students with a basic introduction to social and psychological aspects of electricity networks, covering theoretical and methodological aspects. Key themes include: ways of thinking about publics in relation to electricity supply (i.e. as energy consumers, users or citizens); public understanding of how networks operate and who operates them; beliefs about blackouts, their impacts, likelihood and causes; and public acceptance of network change. In addition, a case study will be presented of public beliefs about the use of hydrogen in the Shetland Islands to store wind-generated electricity. Finally, a basic introduction to social research methods will be provided, covering issues such as ethics, qualitative and quantitative methods.

Monday will begin with an introductory overview of psychology as a discipline of study, including aspects of theory and research method. This aims to lay a foundation for the materials covered subsequently. After lunch, the focus upon energy systems will begin with sessions on public perceptions and acceptance of different renewable energy technologies, including the so-called 'NIMBY' (Not In My Back Yard) explanation for public opposition to technologies such as wind turbines and high voltage pylons. This will be followed by a session on the public understanding of science and technology, covering issues such as social values and lay versus expert understandings of scientific or engineering knowledge.

On day two, the focus upon renewable energy, public understandings and acceptance will continue with a session on the issue of intermittency or variability, and how this aspect of certain renewable energy technologies has been an integral element of public controversies around the siting of wind turbines, revealing assumptions about the national grid and its potential vulnerability to blackouts. This will be followed by sessions throughout the rest of the day about the use of hydrogen for electricity storage, building upon a case study of the PURE wind/hydrogen project in Scotland, and involving issues such as risk perception, social values, public understanding and socio-economics.

On day three, the morning sessions will focus upon the demand side, covering issues such as how domestic electricity users are commonly conceived by industry and policy stakeholders, and prospects for 'smart' metering in the UK. After lunch, this will be followed by sessions on public understanding and acceptance of electricity network technologies, run as participatory workshops where course participants will have the opportunity to test out different social research methods used to capture public beliefs about familiar or unfamiliar technologies.

The final day of the course will begin with a session that reviews work on public beliefs about blackouts, and presents original research findings about their perceived causes, likelihood and consequences. The course concludes with a workshop in which the participants are encouraged to cross disciplinary boundaries by considering the links between important engineering, social and economic aspects of network technologies.

The course will be held at the University of Exeter.

For further details, contact P.G.Devine-Wright@exeter.ac.uk

To register, contact r.j.green@bham.ac.uk



Intensive Course in Electricity Economics

Professor Richard Green, University of Birmingham, 19-22 April 2010

This course will provide students with an introduction to the key aspects of economics relevant to the electricity industry. Key themes will include the relationship between costs and market prices, methods of regulating monopolies, and the desirable level of investment. Ways of internalising environmental effects, such as carbon emissions, will be considered at length during the course.

Monday will be spent introducing key concepts from economics, including demand and supply, profit-maximising pricing and investment behaviour by firms, and game theory. We will also go through a set of company accounts to show how the profit and loss account, balance sheet and cash flow statement are related to each other. This day of the course will be completely self-contained, so participants who are already familiar with this material can join the course on Tuesday morning.

Tuesday will start with an overview of the electricity industry and its different segments – generation, transmission, distribution and retailing (supply). We will then look at the traditional approach to minimising operating and investment costs for generation, which consists of merit-order operation and least-cost investment planning. This approach, suitable for a vertically integrated monopoly, has been superseded by the trend towards liberalisation in many countries around the world over the last twenty years, but we will show how the “perfect” market would produce the same cost-minimising result. Real-world markets are not perfect, of course, and we will discuss some of the ways in which they fall short of the ideal, and their consequences. One of the main issues here is market power, and we will show how generators can raise prices in markets where there are only a few active firms.

Another problem with real-world markets is that they normally fail to take account of environmental effects. On Wednesday, we will discuss policies for dealing with environmental externalities, such as carbon emissions, and promoting renewable generators. This will include material on the EU emissions trading scheme, on feed-in tariffs for renewable energy and on tradable green certificates, such as the UK’s Renewables Obligation Certificates. We then consider transmission, and how electricity wholesale markets must take account of its effects. There are two main ways in which they do – nodal markets set a price for every point on the network, and use these prices to give generators an incentive to operate in a way that takes network effects into account. Zonal markets set fewer prices – sometimes only one for a whole country – and then rely on transactions between the transmission system operator and particular generators to deal with network constraints. We will end the day with a discussion of retailing, and ways of allowing customers to choose their supplier.

On Thursday, we discuss the regulation of the natural monopoly parts of the industry, the transmission and distribution networks. We will show how regulation is affected by the asymmetry of information between the regulated firm and its regulator, and how techniques such as yardstick competition and offering a menu of regulatory options can reduce this asymmetry. In a hands-on exercise, groups of participants will act as a regulator who has to set a price cap for a regulated firm, using the building block approach adopted by British regulators. The last part of the course will discuss the progress of the European Union’s liberalisation programme, and the prospects for further measures currently under discussion.

The course will be held at the University of Birmingham’s campus in Edgbaston, three miles south-west of the city centre. Accommodation is available on the campus, or at city centre hotels a short bus or train journey away from the campus.

For further details, or to register, contact r.j.green@bham.ac.uk