

## **Smart Power Systems ESE-910**

### **Background**

1. Give brief rundown of the existing program.
  - a. Electric power system (EPS) starts from the generating units transforming mechanical energy into electrical energy, then comprises of transmission system which transports the bulk electrical energy and the final part involves the distribution of electrical energy to end consumers for utilization. Earlier the whole power sector was vertically integrated i.e Generation, transmission and utilization were dealt by a single entity responsible for the smooth running of the sector. However with the inception of Renewable energy sources and intent to mitigate monopolies of the generation companies, it was proposed to disintegrate the electric power sector into generation, transmission and distribution companies. These three utilities would be independent and would be responsible for the operation in their respective domains.
  - b. With the unbundling or deregulation of power system, electricity is now considered as a commodity and the consumer is provided with the liberty to purchase power from whichever producer he wants to obtain. Hence the concept of power markets is introduced in Europe.
  - c. The course on “Smart Electricity for emerging energy markets” will emphasis the importance of unbundling electric power sector and how the introduction of carbon credits can help to promote the penetration of Renewables.
  - d. The course presents an in-depth interdisciplinary perspective of electric power systems, with regulation providing the link among the engineering, economic, legal and environmental viewpoints

### **Rationale**

2. Rationale for offering/launching the new course.
  - a. The knowledge acquired in the course will provide the comprehensive understanding of electric power systems that will be needed for research in this field, as well as for future professional activities in the energy sector, whether in industry, government or consulting.
  - b. The course will make available the engineering, economic and legal basis to critically evaluate the regulatory instruments that are used

worldwide for electricity supply activities that are performed as regulated monopolies or under competitive conditions.

### **Educational Objectives**

3. Objectives of the program under which the proposed course will be conducted
- The objectives of this Smart electricity for emerging energy markets course are:
- (1) To provide comprehensive understanding of electric power systems to the students.
  - (2) To discuss the need of disintegration of electric power system and how it will impact the relation of consumers with the utilities.
  - (3) To discuss the functioning of generation, transmission and distribution companies under deregulated environment.
  - (4) To evaluate the tariff under regulated and deregulated environment.
  - (5) To identify the role of distribution companies in increasing the energy efficiency.
  - (6) To discuss the role of carbon markets and prices.

### **International Practice**

4. Specify the universities of repute where the proposed course is being conducted.
- ii. Massachusetts institute of Technology(MIT),USA
  - iii. University of Waterloo, Canada
  - iv. Norwegian University of Science and Technology, NTNU, Norway

### **Proposed Timeframe of Commencement**

5. Specifying semester with year. Summer 2015

### **Course Contents**

6. Give details of the course, on the following lines:
- |                 |                     |
|-----------------|---------------------|
| a. Course Code  | ESE- 910            |
| b. Title        | Smart Power Systems |
| c. Credit Hours | 3                   |

7. **Objectives**

The outcomes of this Smart Electricity for Emerging Energy Markets course are:

- (7) To impart the advance understanding of electric power system to the students.
- (8) To discuss the need of deregulation of power sector.
- (9) To recognize the benefits of deregulation of the sector.
- (10) To discuss the legal, environmental and economic viewpoints of the deregulation.
- (11) To discuss power markets introduced in Europe

8. **Outcomes**

- (12) The students will be able comprehend the operation and management of power system.
- (13) The students will be able to understand Generation dispatch, demand response, and optimal network flows under regulated and deregulated environment.
- (14) The students will be able to have a detailed insight of risk allocation, reliability of service, renewable energy sources, ancillary services, tariff design, distributed generation, rural electrification, environmental impacts and strategic sustainability under both traditional and competitive regulatory frameworks.

f. Contents with suggested contact hours

No.	Topics	Text Book	Contact Hours
1	<b>Power system operation and management</b> 1. Continuity of Supply 2. Adequacy of supply at appropriate reliability 3. Environmental impact of power Generation	A	3
2	<b>The regulatory function</b> 1. Need of Regulation 2. What type of Regulation is required 3. Impact of Regulation on utilities and	A	2

	consumers		
3	<b>Distribution and regulation of monopolies</b> 1. How to regulate a network monopolistic activity 2. Efficient services of a distribution company	B	3
4	<b>Electricity generation: optimization models, theory and practice of wholesale markets.</b> 1. Designing of an efficient, reliable, adequate and environmental friendly mechanism of power production 2. Optimum investments in the transmission network 3. Functioning of transmission network under deregulated environment	B	6
5	<b>Transmission</b> 1. Impact of the transmission network on the functioning of wholesale electricity markets 2. Solution to Improve Voltage Drop 3. Line Losses Definition 4. Calculation of Line Losses 5. Function of Capacitors, Optimal Placement	A	4
6	<b>Electricity tariffs</b> 1. Calculation of tariff under regulated and deregulated environment 2. Reflection of cost of different activates in the cost of electricity	C	3
7	<b>Retail markets</b> 1. Extension of retail competition to all the end consumers 2. Implementation of retail markets ? 3. Active participation of demand in the functioning of the power system	B	5
8	<b>Generation from renewable energy sources</b> 1. What is different in generation from renewable energy sources with respect to generation from other sources?	A	6

	<ol style="list-style-type: none"> <li>2. What is the justification of separate regulatory regimes?</li> <li>3. Which regulatory instruments have been used and/or proposed to promote renewables?</li> <li>4. Which ones have worked and which ones have not and why?</li> </ol>		
9	<p><b>Regional electricity markets</b></p> <ol style="list-style-type: none"> <li>1. What is the justification of establishing regional/multinational electricity markets?</li> <li>2. What are the new regulatory topics to be considered in the regional context?</li> <li>3. What can be learned from existing international experiences?</li> </ol>	A	4
10	<p><b>Universal access to electricity</b></p> <ol style="list-style-type: none"> <li>1. How many people still lack access to electricity?</li> <li>2. What is the impact on human development?</li> <li>3. What has been the impact of the recent regulatory reforms on access to electricity?</li> <li>4. What could be adequate approaches to achieve universal electricity access?</li> </ol>	B	4
11	<p><b>CO<sub>2</sub> markets and prices</b></p> <ol style="list-style-type: none"> <li>1. What are the major potential elements of the future global regime to address climate change?</li> <li>2. Kyoto Protocols</li> <li>3. What could be the role of carbon markets and prices? How could this affect electricity markets?</li> </ol>	B	3
12	<p><b>Energy Efficiency</b></p> <p>What roles should electric distribution utilities play in promoting energy efficiency and responsive energy?</p>	A	2
	<b>Total</b>		45

g. Recommended Reading (including Textbooks and Reference books).

S. No.	Title	Author(s)	Assigned Code	Remarks
1	Electric Energy Systems: Analysis and Operation	Antonio Gomez-Exposito , Antonio J. Conejo, Claudio Canizares	AG	Text
2	Competitive Electricity Markets: Design, Implementation, Performance	Fereidoon P. Sioshans	FP	Reference
3	Electricity Market Reform: An International Perspective	Fereidoon P. Sioshansi	FP	Reference