Southern Alberta Section
IAS-PES Chapter

Power System Stability and Control

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This course will provide a comprehensive overview of power system stability and control problems. This includes the basic concepts, physical aspects of the phenomena, methods of analysis, examples of incidents of system instability, challenges to the secure operation of present-day power systems, and comprehensive approach to enhancing system security.

Attendees will receive a copy of the book *Power System Stability and Control* by Prabha Kundur, McGraw-Hill, Inc., 1994, which will be used as a reference for the course. Course notes will be provided on the first day, on a USB jump drive. Attendees should bring their own laptops to follow-along with the notes.

Course Outline:

1. Introduction to Power System Stability
2. Review of Equipment Characteristics and Modelling
3. Control of Active Power and Frequency
4. Control of Reactive Power and Voltage
5. Transient (angle) Stability
6. Small-Signal (angle) Stability
7. Sub-synchronous Torsional Oscillations
8. Voltage Stability
9. Frequency Stability
10. Wind and Solar Power Plants
11. Major Power Grid Blackouts in Recent Years
12. Comprehensive Approach to Power System Security

See below for a detailed course agenda.

This course qualifies for Continuing Professional Development activity, and provides 28 Professional Development Hours (PDHs). Participants who successfully complete the course will receive a PDH certificate from IEEE within 14 business days of completion.

Location:	The Carriage House Inn, Windsor A Room 9030 Macleod Trail South, Calgary, Alberta	
Date:	Monday, September 17, 2018 to Thursday, September 20, 2018	
Time:	8:30AM to 5:00PM Lunch is included.	All times are: Canada/Mountain
Cost:	IEEE Members Non Members Full-time IEEE Students (must be sponsored by a professor)	$1500 $2100 $750

Alberta employers may qualify for the “Canada-Alberta Job Grant” training incentive program, where the government reimburses employers up to 2/3 of the training costs. See: http://www.AlbertaCanada.com/JobGrant

Register at: https://events.vtools.ieee.org/m/172273 Registration closes Sept 6.

Speaker:

Prabha Kundur

Prabha Kundur holds a Ph.D. in Electrical Engineering from the University of Toronto and has over 40 years of experience in the electric power industry. He is currently the President of Kundur Power system Solutions Inc., Toronto, Ontario. He served as the President and CEO of Powertech Labs Inc., the research and technology subsidiary of BC Hydro, from 1994 to 2006. Prior to joining Powertech, he worked at Ontario Hydro for nearly 25 years and held senior positions involving power system planning and design.

He has also served as Adjunct Professor at the University of Toronto since 1979 and at the University of British Columbia from1994 to 2006. He is the author of the book Power System Stability and Control (McGraw-Hill, 1994), which is a standard modern reference for the subject. He has performed extensive international consulting related to power system planning and design, and has delivered advanced level technical courses for utilities, manufacturers and universities around the world.

Dr. Kundur has a long record of service and leadership in the IEEE. He has chaired numerous committees and working groups of the IEEE Power & Energy Society (PES), and was elected a Fellow of the IEEE in 1985. He served as the Chair of the IEEE Power System Dynamic Performance Committee from 2001 to 2003. From 2004 to 2010, he served as a member of the IEEE PES Executive Committee and as the PES Vice-President for Education. He is the recipient of several IEEE awards, including the 1997 IEEE Nikola Tesla Award, 2005 IEEE PES Charles Concordia Power System Engineering Award, and the 2010 IEEE Medal in Power Engineering.

Dr. Kundur has also been very active in CIGRE for many years. He served as the Chairman of the CIGRE Study Committee C4 on “System Technical Performance” from 2002 to 2006, and as a member of the CIGRE Administrative Council from 2006 to 2010. He is the recipient of the CIGRE Technical Committee Award in 1999. He was awarded the CIGRE Medal in 2014.

Dr. Kundur was elected as a Fellow of the Canadian Academy of Engineering in 2003 and as a Foreign Associate of the US National Academy of Engineering in 2011.

He has been awarded two honorary degrees: Doctor Honoris Causa by the University Politechnica of Bucharest, Romania in 2003, and Doctor of Engineering, Honoris Causa by the University of Waterloo, Canada in 2004.

Please contact Carl Moller [cmoller@groundcan.com] if you have any problems registering for the seminar, or if you have any questions.

Day 1

1. Introduction to Power System Stability

- Definition and classification of power system stability
- Brief description of each category of system stability
- Conceptual relationship between power system stability, security and reliability
- Traditional approach power system security assessment
- Challenges to secure operation of present-day power systems

2. Review of Equipment Characteristics and Modelling

- **Synchronous machines:** theory and modelling, machine parameters, saturation modelling, synchronous machine representation in stability studies, reactive capability limits.
- **Excitation systems:** elements of an excitation system, types of excitation systems, control and protective functions, modelling.
- **Prime movers and governing systems:** hydraulic turbines and governing systems, steam turbines and governing systems, gas turbines and combined-cycle units.
- **Generating unit testing and model validation:** test procedures, current industry practices.
- **AC Transmission:** performance equations and parameters, surge impedance loading, voltage-power characteristics, reactive power requirements, loadability characteristics, factors influencing transfer of active and reactive power.
- **Power system loads:** basic modelling concepts, static and dynamic models, acquisition of load model parameters.

3. Control of Active Power and Frequency

- Fundamentals of frequency control
- Composite regulating characteristics of power systems
- Automatic generation control
- Under-frequency load shedding

Day 2

4. Control of Reactive Power and Voltage

- Control objectives
- Production and absorption of reactive power
- Methods of voltage control
- Principles of reactive compensation in transmission systems
- Static and dynamic compensators
- Coordinated control of reactive power and voltage

5. Transient (angle) Stability

- An elementary view of the transient stability problem
- Simulation of power system dynamic response
- Numerical integration methods
- Performance of protective relaying
- Case Studies
- Transient stability enhancement
- Examples of major system blackouts due to transient instability

Day 3

6. Small-Signal (angle) Stability

- Nature and description of small-signal stability (SSS) problems

- Methods of analysis; modal analysis approach
- Characteristics of local-plant mode and inter-area mode oscillations
- Case studies
- SSS enhancement
- Examples of major system disturbances due to small-signal instability

7. Sub-synchronous Torsional Oscillations

- Steam turbine generator torsional characteristics
- Torsional interaction with power system controls: PSS, HVDC converter controls
- Subsynchronous resonance
- Impact of network-switching disturbances

8. Voltage Stability

- Description of the phenomenon
- Factors influencing voltage stability
- Methods of analysis
- Typical scenarios of short-term voltage instability and long-term voltage instability
- Prevention of voltage instability
- Case studies
- Examples of major system disturbances due to voltage instability

Day 4

9. Frequency Stability

- Nature and description of frequency stability problems
- Examples of system disturbances caused by frequency instability
- Analysis of frequency stability problems
- Case studies
- Mitigation of frequency stability problems.

10. Wind and Solar Power Plants

- Types of wind turbine generator technologies and their characteristics
- Topology and characteristics Solar PV Plants
- Impact on power system dynamic performance
- Performance requirements and grid integration issues

11. Major Power Grid Blackouts in Recent Years

- Description of events
- Causes of blackouts; Lessons learned

12. Comprehensive Approach to Power System Security

- Application of robust power system controls
- Defense plan against extreme contingencies
- Restoration plans
- On-line security assessment
- Reliability management system
- Wide-area monitoring and control
- Widespread use of distributed generation
- Effective formation of Microgrids