Instructor: Prof. Siddharth Suryanarayanan  
Office: Engineering B116  
Office hours: 3:00pm–5:00pm Wednesday  
Other times by appointment only (for Prof. Suryanarayanan’s calendar, see: [https://goo.gl/Uu9VbV](https://goo.gl/Uu9VbV))  
Phone: (970) 491-4632  
Email: sid@colostate.edu  

Lecture time and venue: 5:15pm–8:00pm Wednesday, Room: Engineering B4  

Textbook: 
None. Notes and technical papers will be supplied by the instructor as deemed fit.  

Prerequisites:  
- ECE 461 (or) ECE/ENGR 508 (or) ECE/ENGR 565  


Course objectives: Electric power distribution systems and networks are undergoing hitherto unprecedented changes in design, asset portfolios, operation, management, and active customer engagement. These critical delivery systems are evolving from passive to active roles driven by the Smart Grid Initiative. This graduate-level course is designed to provide an introduction to the emerging concept of smart electric power distribution systems. The emphasis of the course is on topics related to microgrids; smart customers, homes, and neighborhoods; topology and assets management; and, demand response and resource allocation.  

In this course students will:  
1. Identify the characteristics of a smart electric distribution system  
2. Translate the above characteristics to study specific innovations in contemporary electric distribution systems such as microgrids, demand response, and asset management  
3. Prepare an annotated bibliography of no less than three references for the material learned in each week  
4. Examine and evaluate emerging trends in smart customers, homes, and neighborhoods vis-à-vis electric energy  
5. Compare and contrast the state-of-the-art to the newly evolving topology and technologies in smart electric distribution systems  
6. Explain via a term paper the future of a contemporary topic in smart distribution systems  
7. Defend a position as a panelist on a contemporary topic in smart distribution systems.  

*OR instructor’s approval.
Assignment of course grade: The grade will be based on the weighted index as shown below.

- Homework ................................................................. 25 %
- Annotated bibliography ............................................. 25 %
- Term paper ............................................................... 25 %
- Panel presentation .................................................... 25 %

Course outline and reading material: Tentative schedule

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Introduction to course and overview of the Smart Grid Initiative in the US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 2</td>
<td>Characteristics of a smart distribution system [1], [2]</td>
</tr>
<tr>
<td>Week 3</td>
<td>Distributed generation and IEEE 1547 family of standards [3], [4]</td>
</tr>
<tr>
<td>Week 4</td>
<td>Microgrids 1: definition, design, and deployment</td>
</tr>
<tr>
<td>Week 5</td>
<td>Microgrids 2: lessons learned in dispatch [5]</td>
</tr>
<tr>
<td>Week 6</td>
<td>Microgrids 3: lessons learned in data collection and analysis [6]</td>
</tr>
<tr>
<td>Week 7</td>
<td>Microgrids 4: relief and recovery activities [7]</td>
</tr>
<tr>
<td>Week 8</td>
<td>Smart customers, homes, and neighborhoods 1: a) engaging the end-user [8] and b) enabling technologies for smart homes [9]</td>
</tr>
<tr>
<td>Week 9</td>
<td>Spring recess</td>
</tr>
<tr>
<td>Week 10</td>
<td>Smart customers, homes, and neighborhoods 2: energy management in smart neighborhoods [10]</td>
</tr>
<tr>
<td>Week 11</td>
<td>Topology modifications and assets management 1: reliability improvement in distribution systems [11], [12]</td>
</tr>
<tr>
<td>Week 12</td>
<td>Topology modifications and assets management 2: a) intelligent distribution substation [13] and b) short-term load forecasting and energy management [14]</td>
</tr>
<tr>
<td>Week 13</td>
<td>Demand response and resource allocation 1 [15], [16],</td>
</tr>
<tr>
<td>Week 14</td>
<td>Demand response and resource allocation 2 [17]</td>
</tr>
<tr>
<td>Week 15</td>
<td>Electric vehicles and energy storage in distribution systems [18], [19], [20]</td>
</tr>
<tr>
<td>Week 16</td>
<td>Advanced topics &amp; Panel presentations</td>
</tr>
</tbody>
</table>

†The instructor may be on business-related travel on some of the lecture dates. In such cases of a conflict in schedule, the
<table>
<thead>
<tr>
<th>Week</th>
<th>Course objectives</th>
<th>Objective level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td>Week 2</td>
<td>1</td>
<td>Engagement</td>
</tr>
<tr>
<td>Week 3</td>
<td>2</td>
<td>Engagement</td>
</tr>
<tr>
<td>Weeks 4–7</td>
<td>2</td>
<td>Mastery</td>
</tr>
<tr>
<td>Weeks 8–10</td>
<td>4</td>
<td>Mastery</td>
</tr>
<tr>
<td>Weeks 11 and 12</td>
<td>5, 6</td>
<td>Mastery</td>
</tr>
<tr>
<td>Weeks 13 and 14</td>
<td>2</td>
<td>Mastery</td>
</tr>
<tr>
<td>Week 15</td>
<td>5</td>
<td>Engagement</td>
</tr>
<tr>
<td>Week 16</td>
<td>3, 6, 7</td>
<td>Mastery</td>
</tr>
</tbody>
</table>

**Important dates:**
- Term paper assigned ................. Week 8
- Drop course without W ................ Week 9
- Term paper due ......................... Week 12
- Panel presentation topic and panelists assigned ........ Week 13
- Panel presentations ................... Week 16
- Full annotated bibliography due ........ Week 16

**Course Policy:**

**Attendance:** Regular attendance is strongly encouraged. Instances of two successive absences will result in a decrease of the final grade by 5% and will accumulate for every repeated occurrence. In specific, this course will include a frequently assigned (weekly) reading assignment that typically requires studying the course material equivalent to a book chapter, which includes reading and understanding the theoretical narrative of the text and relating this material to the class lectures, performing independently (by the student) the associated derivations from the textbook, and carrying out independently (by the student) the examples (worked-out problems and exercises) from the textbook and/or reference sources. The reading assignments are essential for the successful and efficient performance on projects and class participation, and as such are evaluated and assessed through all assessed/graded items included in the course outline.

**Canvas use policy:** The instructor will exclusively use the Canvas facility to communicate with the individual and the class regarding the course. So, it is imperative that the student has a functioning email (usually, it is the colostate.edu email id) associated with the Canvas website to receive all notifications. The instructor does not take any responsibility for sending information to students via any other means or to another email id than the one associated with Canvas.

Respective lecture will be recorded sans audience and made available via the class URL on Canvas or a guest lecturer may be invited to substitute or the lecture may be canceled.
**Make-up:** Except under documented cases of extenuating circumstances, there will be no opportunity for a make-up for any portion of the class component towards the final grade.

**ADA Statement:** Students with disabilities are encouraged to register with the Office for Student Services to determine the appropriate classroom accommodations. Any student with verification of a disability should contact the instructor as soon as possible, and will be accommodated in an appropriate manner.

**Term paper:** Each student enrolled in the course is required to choose a contemporary topic of research interest in the field of smart electric distribution systems. The instructor will assign this project in the 8th week of classes in the semester. The student is expected to perform high quality literature search and draw conclusions about state-of-the-art and the future of the topic chosen. A technically sound research paper on the topic of choice written in the form of a conference paper (according to the IEEE PES template) is a required deliverable from each student/team in the 12th week of classes in the semester. The template will be provided to the students or can be obtained at the following link ([https://goo.gl/8iKeQ9](https://goo.gl/8iKeQ9)).

**Annotated bibliography:** Each student (or team of no more than two students) enrolled in the course is required to deliver an annotated bibliography consisting no less than three references sources for each week’s lecture topic. The full annotated bibliography is due on the 16th week of classes in the semester. For more information on what constitutes an annotated bibliography, visit [https://goo.gl/M6XLxx](https://goo.gl/M6XLxx).

**Panel presentation:** Each student enrolled in the course is required to participate on a panel and defend a position. This is scheduled on the 16th week of classes in the semester. Each panel will have three (or four) student participants. The topics of the panels will be decided by the instructor and conveyed to the class during the 13th week of the classes in the semester. Each student panelist will present a lecture for 15 minutes followed by a Q&A session of 10 minutes.

**Academic Honesty:** Academic integrity is of utmost importance. For a description on practicing academic integrity, go to [http://tilt.colostate.edu/integrity/](http://tilt.colostate.edu/integrity/). Colorado State University’s Writing Center defines plagiarism as “the unauthorized or unacknowledged use of another person’s academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding credit be given where credit is due.”

Departures from accepted norms of academic integrity will be dealt with full compliance to CSU principles published in the CSU General Catalog. Visit [http://goo.gl/6opQt7](http://goo.gl/6opQt7) for information on the CSU policies pertaining to this.

The instructor may use a CSU designated resource for verification of plagiarism in any work that is submitted by a student for grade in this course.

Visit [http://tilt.colostate.edu/integrity/pledge/](http://tilt.colostate.edu/integrity/pledge/) for familiarizing with the CSU Honor Pledge.

**Reading material**


**Resources for technical writing**

- Purdue Online Writing Lab (OWL), [Online Available]: https://owl.english.purdue.edu/owl/, Last accessed on: 25/7/2017.