1. **Course number and name**
   EE/CptS 439: Cyber-Infrastructure for the Smart Electric Grid

2. **Credits and contact hours**
   3 credits, 3 lecture hours

3. **Instructor's or course coordinator's name**
   Anurag K Srivastava

4. **Textbook, title, author, and year**
   G. Coulouris, J. Dollimore, T. Kindberg, and G. Blair. 2011. *Distributed Systems: Concepts and Design* (5th ed.). Addison Wesley.

5. **Specific course information**
   a. *Catalog description:* Introduction to smart electric grid, communication networks, distributed computing, fault tolerant computing, cyber security, analyzing interdependencies between the smart grid components, smart grid standards and protocols.
   b. *Prerequisites or corequisites:* Senior or graduate student in engineering.

6. **Specific goals for the course**
   By the end of the course, students will be able to
   - Identify, formulate, analyze and solve complex computing and engineering problems by applying principles of engineering, computing, science, mathematics, and other relevant disciplines (1a, 1b, 1c, 1d, 1e)
   - Design, implement and evaluate engineering and computing solutions that meet specified requirements with consideration of public health, safety, and welfare concerns, as well as global, cultural, social, environmental, and economic factors (2b,2c,2d,2e)
   - Effectively communicate reasoning and rationale in written documents (3a, 3b, 3c, 3d, 3e).
   - Carefully listen to others and provide others with constructive feedback (5g).
   - Function effectively as part of a team (5b, 5c, 5d, 5e, 5f).
   - Effectively manage team projects (5a, 5c, 5d).
   - Apply appropriate computing and engineering approaches, theories, and fundamentals to conduct appropriate experimentation, analyze and interpret data, use engineering judgment to draw conclusions, and produce solutions (6a, 6b, 6c, 6d)

7. **Brief list of topics to be covered**
   - Overview and Introduction to Smart grid
   - Sense, communicate, compute and control in secure way
   - Performance objective, SCADA, NERC/FERC, operational standards
   - Layered communication model, physical & link layers, network layer

- Transport layer: datagram and stream protocols; Glue protocols: ARP, DNS, Routing
- MPLS; Power system application-layer protocols: SCADA, ICCP, IEC 61850, C37.118; multi-cast and its uses
- Utility IT infrastructures; control center structure & software; CIMs, IEC 61850 and 61970
- Fault-tolerant computing basics; distributed computing basics
- Distributed computing architectures; middleware; WAMS data delivery requirements and mechanisms
- Basic concepts and applications of cryptography, software vulnerabilities
- Malware, network attacks, web security, Stuxnet
- Network protection, security testing, security practices, governmental efforts
- Overall system architecture, WAMS application, NERC CIP standards, Case studies
- Review of interdependencies of cyber-physical smart electric grid and discussions