# Cyber-security Control and Sensing Technology for Future Smart Grids

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Cyber-attacks can interfere either directly or indirectly with monitoring and control in power systems, leading to cascading failures and blackouts. As the electricity grid becomes increasingly distributed and reliant on emerging telecommunication and control technologies (e.g. 5G wireless and narrowband internet of technology (IOT) networks), vulnerabilities to cyber-attacks will increase, and more sophisticated approaches to intrusion detection and management will be required, e.g. approaches that can also differentiate between cyber-attacks and other natural disruptions to normal operation. Due to these growing concerns, the USA power grid has decided to upgrade the control system in the near future to enable the detection of cyber-attacks. The grids in developing countries will require highly reliable secure control as they will be more prone to threats.

To accommodate cyber-secure control and required sensing technology, a huge adequately trained workforce shall be required in the future power industry. The electrical engineer who works in the interdependent critical power, communication and electrified transportation sectors will encounter challenging problems in designing future networks to deliver an increasing amount of electrical energy in a safe, reliable and resilient manner. Another important challenge for the electrical engineer is to develop smart and reliable sensors for implementing cyber-secure control for the future smart electricity grids.

Therefore, this course will be delivered to equip students/engineers with the knowledge and skills necessary for designing and implementing cyber-secure control strategies for the future smart power net-works. Students/engineers will be provided an opportunity to learn the advancement of sensing technology; important sensing parameters, low cost fabrication based on flexible electronics, and interfacing of the sensor and conditioning of the sensing signal. The attendee will also acquire extensive coherent advanced knowledge of designing, fabrication and implementation of smart and reliable sensors for improving cyber security of smart grids (SG).

This course is different from other existing courses related to smart grids as it will mainly focus on the identification of cyber-attacks based on power system behaviors, and links cyber-security and robust control in single framework. Participants will also know about the sensing devices and challenges to design the sensors for smart grid applications. Participants will receive tutorial about the modelling of cyber security system and practical exposure of design and fabrication of some sensors. This is a research cum higher undergraduate level course and it is interdisciplinary in nature.

## Objectives:

The primary objectives of the course are as follows:

- Importance and challenges of implementing cyber-secure control methods and appropriate sensing technologies for smart grids.

- Development of necessary human skill-set to model, design, implement cyber secure control for today's inverter dominated power networks and associated suitable sensors for smart grids.

- To train the students/engineers on the best methods to detect cyber-attacks based on power system behaviors.

- To develop skills to identify, design and implement of suitable sensors for implementing cyber-secure controllers.

- To provide knowledge and skills on the broad range of technologies including sensing, communications, advanced control and machine intelligence.

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| **Modules** | **A:** **Duration:** **23rd May 2022 to 27th May 2022** (Lectures: 15 hrs, Tutorials/Practical: 6 hrs.)<br>**B:** **Venue:** **Department of Electrical Engineering, Jamia Millia Islamia Central University,** New Delhi-25, India<br><br>**Lecture-wise course plan: (ALL LECTURES WILL BE CONDUCTED ONLINE)**<br><br>**Monday, May 23, 2022:**<br>• **Lecture 1-2: 10**:30 am – 12:30 pm-Jahangir Hossain<br>  **Introduction to Smart Grids, Emerging Technologies and Cyber Issue:** Security Requirements, Challenges of Upgradation of Existing Power System Controllers Including Security Issues and Detection Techniques.<br>• **Lecture 3-4: 2**:30 Pm – 4:30 pm-Tariqul Islam<br>  **Sensing Technology for Smart Grids:** Sensors for condition monitoring of power system apparatus like T/F<br><br>**Tuesday, May 24, 2022:**<br>• **Lecture 5-6:** 9:30 am – 11:30 am Jahangir Hossain<br>  **Cyber-security and Power System Contingencies:** Classification of Cyber-attacks in Power Systems, and their Analysis. **Internet of Things (IOT) and Smart Grids:** Architectures, Applications, Integrations of IoT in SG, Security Issues in IoT aided SG .<br>• **Hands-on Tutorial/Practical 1:** 11:30 pm – 12:30 pm Jahangir Hossain<br>• **Lecture 7-8:  2:30 PM to 4.30 PM Sensing Technology for Smart Grids:** Sensors for Density and Moisture Measurement in GIS, Tariqul Islam<br><br>**Wednesday, May 25, 2022:**<br>• **Lecture 9-10**: 9:15 am – 11:15 am Jahangir Hossain<br>  **Detection of Cyber-attacks based on Power System Characteristics:** Conventional Detection system and its Limitations, Intrusion detection systems in Computer Net., AI in Detecting Cyber-attacks and its limitations)<br>• **Hands-on Tutorial/practical 2**: 11:30 pm – 1:00pm  Jahangir Hossain<br><br>**Thursday, May 26, 2022:**<br>• **Lecture 11-12**: 9:30 am – 11:30 am,  Jahangir Hossain<br>  **Cyber-secure Control**: DC Microgrid-Modeling, Controller Design, Implementation and Validation, distributed Consensus- based Cybersecure Control Design, Implementations, Security principle for renewable generators and smart meters<br>• **Lecture 13**: 11.30-12.30, Tariqul Islam<br>  Smart Sensors and Internet of Things for Smart Grids<br>• **Hands-on Tutorial/practical of sensor design and simulation  3**: 2:30 pm – 4:30pm  Tariqul Islam<br><br>**Friday, May 27, 2022:**<br>• **Lecture 14-15**: 9:30 am – 11:30 am  Jahangir Hossain<br>  **Testbeds and Education Platforms:** Existing Platforms and Their Inadequacies, Low-cost testbeds for Cybersecurity Research in India.<br>  **Lecture 16:** 11.30-12.30 PM **, Writing research article with ethical practices, Tariqul Islam**<br>• **Exam and Evaluation of Participants**: 2:00 pm – 3:00 pm<br><br>*Number of participants for the course will be limited to forty.* |
| **Who can join if** | ▪ you are a scientist/researcher from industry and government organizations.<br>▪ you are a student of **B. Tech//MTech/PhD, post-doctoral fellow or faculty** from reputed academic institutions interested in pursuing research career in Smart Grids, Cyber security, Sensors based condition monitoring of smart grids. |
| **Fees** | **Participants from abroad: US $200 Industry/ Research,**<br><br>**Academic Institutions:**<br>• **Faculty members:     Rs.  1500/- ,**<br>• **Students:             Rs.  750/-**<br><br>The above fee includes all instructional materials, tutorials and assignments, grade sheet and certificates. |

# The Faculty

**Jahangir Hossain** (M'10-SM'13) received the B.Sc. and M.Sc. Eng. degrees from Rajshahi University of Engineering and Technology (RUET), Bangladesh, in 2001 and 2005, respectively, and the Ph.D. degree from the University of New South Wales in 2010, Australia, all in electrical and electronic engineering.

He is currently an Associate Professor with the School of Electrical and Data Engineering, University of Technology, Sydney, Australia. Before joining there, he served as an Associate Professor in the School of Engineering, Macquarie University, Senior Lecture and a Lecturer in the Griffith School of Engineering, Griffith University, Australia for five years and as a Research Fellow in the School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, Australia. He worked as lecturer and assistant professor for more than six years at RUET. He has supervised more than 25 HDR students and several MTech students. He has published more than 240 articles including 100 research papers in peer reviewed journals of high reputes, one research contributed book, 3 edited books, 5 book chapters in reputed edited books and more than 120 conference papers. His current research citation is 5250 with H-Index 39. He has received total research grant more than $5 M. He is a senior member of IEEE and eidtor of two reputed journals. His research interests include renewable energy integration and stabilization, voltage stability, micro grids and smart grids, robust control, electric vehicles, building energy management systems, and energy storage systems. Further details about Prof. Hossain can be seen at his homepage:https://www.uts.edu.au/staff/jahangir.hossain.

**Tariqul Islam** ((M'16-SM'18) received the Ph.D degree from Jadavpur University, Kolkata, India, in 2007. He is Professor in the Electrical Engineering Department, Jamia Millia Islamia (Central University), New Delhi with over 20 years of experiences in Academic and Research.

His current research interests are sensing technology and electronic instrumentation. The sensing technology includes capacitive sensors, conductive sensors, impedance sensors, sensors array for electronic nose, SAW sensor for various applications such as health monitoring of transformer, gas insulated switch gears (GIS), moisture measurement for electronic gases, automatic dispensing system, measurement of pressure, temperature, density, liquid level, and the quality assessment of liquid drinks. He has supervised more than 16 Ph.D students and more than 28 M Tech students. Prof Islam has published more than 80 research papers in peer reviewed journals of high reputes (40 papers in IEEE Trans.), 85 papers in conferences, 4 edited books, 10 edited book chapters and filed four patents. His current research citation is 1600 with H-Index 22. He has received research grant from DST, DAE, CPRI, MHRD DRDO. He is a senior member of IEEE, life member of ISTE, IETE, and ICTP. He is a Topical editor of IEEE Sensors journal, an Associate Editor of IEEE Transactions on Instrumentation and Measurement. He received best AE awards from IEEE Sensors council (2017, 2018) and IEEE Trans. on Instrum. And Meas. (2020). Further details about T. Islam can be seen at **http://jmi.ac.in//electrical**.

## Course Co-ordinator

**Prof. Tarikul Islam**
**Department of Electrical Engineering (NBA Accredited for 6 years in 2019)**
**Jamia Millia Islamia (A Central University, NAAC Grade A++, NIRF Rank 6th) Jamia Nagar, New Delhi – 110025, India**

Mobile: 08800902585
E-mail: tislam@jmi.ac.in

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Course Registration Link:

https://gian.iitkgp.ac.in/ccourses/approvecourses3

## Registration fee payment details

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| Address | Jauhar Ali Marg, Sport Complex, Jamia Nagar New Delhi-110025, 011-26985869 |