# NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

| COURSE PLAN – PART I | | | |
|---|---|---|---|
| **Name of the programme and specialization** | **M.Tech. (Power Systems)** | | |
| **Course Title** | SMART GRID TECHNOLOGIES | | |
| **Course Code** | **EE 680** | **No. of Credits** | **3** |
| **Course Code of Pre/ Co-requisite subject(s)** | **NONE** | | |
| **Session** | **July 2021** | **Section (if, applicable)** | **-** |
| **Name of Faculty** | **Dr. M. P. SELVAN** | **Department** | **EEE** |
| **Email** | **selvanmp@nitt.edu** | **Telephone No.** | **9444170638** |
| **Name of Course Coordinator(s) (if, applicable)** | | | **NA** |
| **E-mail** | **-** | **Telephone No.** | **-** |
| **Course Type** | ☐ **Core course** | ✓ **Elective course** | |

| | |
|---|---|

## Syllabus (approved in BoS)

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid, Technology Drivers.

Energy Management System (EMS) - Smart substations - Substation Automation - Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources – Energy Storage.

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

**Reference Books:**
1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.

3. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015

4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 'Communication Networks for Smart Grids', Springer, 2014

## COURSE OBJECTIVES

1. To understand the need and concept of Smart Grid

2. To study different EMS and DMS functions and smart meters

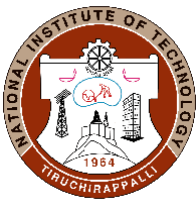3. To get familiarized with the communication networks for Smart Grid applications

## COURSE OUTCOMES (CO)

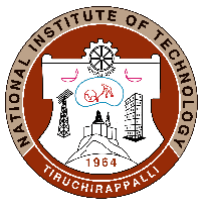| Course Outcomes | Aligned Programme Outcomes (PO) |
|---|---|
| Upon completion of the course, the students will be able to | |
| 1. Get acquainted with the smart resources, smart meters and other smart devices. | 1, 2, 7, 8, 11, 12, 13, 14 |
| 2. Describe how modern power distribution system functions. | 1, 2, 5, 6, 7, 8, 11, 12, 13, 14 |
| 3. Identify suitable communication networks for smart grid applications. | 1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14 |

## COURSE PLAN – PART II

### COURSE OVERVIEW

Students learn about power system in many power system courses such as power system analysis, power system operation and control, power system protection and switchgear, restructuring of power system, etc. All these subjects deal with the modeling, analysis and control of regulated and/or deregulated power system. On the other hand, Smart grid technology is a collection of existing and emerging technologies working together to achieve energy efficieny, automation and financial benefits in the production, transport and consumption of electrical energy. Smart gird technologies involve integration of renewable energy sources into the conventional power grid both at the transmission and distribution level, employing FACTS and HVDC transmission systems, realising wide area monitoring and protection system and adopting information and communication technolgy for consumer participaton in the grid operation. In this course, students learn about the requirement for a smart grid in future. Further, students will be exposed to several modern and evolving technologies that can be applied in transforming the present power grid into smart power grid. They will also be educated about the issues in the implementation of smart grid and present scenario in the national and international levels.

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| S.No. | Week/Contact Hours | Topic | Mode of Delivery |
|---|---|---|---|
| **COURSE TEACHING AND LEARNING ACTIVITIES** | | |
| 1 | Week 1<br>06-09-2021 to 10-09-2021<br>(2 Contact Hours) | Introduction & Course plan details | Online<br>MS Teams |
| 2 | Week 2<br>13-09-2021 to 17-09-2021<br>(3 Contact Hours) | Evolution of electric grid, Smart Grid Concept, Definition and Need for smart Grid, Functions, Benefits and Challenges | Online<br>MS Teams |
| 3 | Week 3<br>20-09-2021 to 24-09-2021<br>(3 Contact Hours) | Difference between conventional & smart grid, Technology drivers.<br>Energy Management System | Online<br>MS Teams |
| 4 | Week 4<br>27-09-2021 to 01-10-2021<br>(3 Contact Hours) | Substation Automation, Feeder Automation, SCADA, Remote Terminal Unit, Intelligent Electronic Devices, Protocols, Phasor Measurement Unit | Online<br>MS Teams |
| 5 | Week 5<br>04-10-2021 to 08-10-2021<br>(3 Contact Hours) | Smart integration of Energy Resources-Renewable, intermittent power sources Energy Storage | Online<br>MS Teams |
| 6 | Week 6<br>11-10-2021 to 15-10-2021<br>(2 Contact Hours) | Distribution Management System, Volt Var Control, Fault Detection, Isolation and Service Restoration | Online<br>MS Teams |
| 7 | Week 7<br>18-10-2021 to 22-10-2021<br>(3 Contact Hours) | Outage management system, Customer Information system, Geographical Information System<br>Effect of plug in hybrid electric vehicles | Online<br>MS Teams |
| 8 | Week 8<br>25-10-2021 to 29-10-2021<br>(3 Contact Hours) | **Assessment – 1**<br>Introduction to Smart Meter, AMI, AMI Protocols, Standards | Online<br>MS Teams |
| 9 | Week 9<br>01-11-2021 to 05-11-2021<br>(1 Contact Hour) | Demand Side Management | Online<br>MS Teams |
| 10 | Week 10<br>08-11-2021 to 12-11-2021<br>(3 Contact Hours) | Demand Response, Importance and functions of HEMS, Demand Pricing | Online<br>MS Teams |
| 11 | Week 11<br>15-11-2021 to 19-11-2021<br>(2 Contact Hours) | Elements of communication and networking | Online<br>MS Teams |
| 12 | Week 12<br>22-11-2021 to 26-11-2021<br>(3 Contact Hours) | **Assessment - 2**<br>PLC, Zigbee, GSM, BPL<br>LAN, HAN, WAN, IP based protocols | Online<br>MS Teams |
| 13 | Week 13<br>29-11-2021 to 03-12-2021<br>(3 Contact Hours) | Web Service and Cloud computing, Cyber security for smart grid | Online<br>MS Teams |
| 14 | Week 14<br>06-12-2021 to 10-12-2021<br>(3 Contact Hours) | **Assessment 3 (Group Task)** | Online<br>MS Teams |

| 15 | Week 15 13-12-2021 to 17-12-2021 (2 Contact Hours) | **Assessment 3 (Group Task) Compensation Assessment** | Online |
|---|---|---|---|
| 16 | Week 16 20-12-2021 to 24-12-2021 (2 Contact Hours) | **Final Assessment** | Online MS Teams |

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

| S.No. | Mode of Assessment | Week/Date | Duration | % Weightage | |
|---|---|---|---|---|---|
| 1 | Surprise Quiz | | | 05 | 25 |
| | Scheduled Quiz | Week 8 | 60 Minutes | 20 | |
| 2 | Surprise Quiz | | | 05 | 25 |
| | Scheduled Quiz | Week 12 | 60 Minutes | 20 | |
| 3 | Group Task | Week 14 & Week 15 | | 20 | |
| CPA | Compensation Assessment | Week 15 | 60 Minutes | 20 | |
| 4 | Final Assessment | Week 16 | 90 Minutes | 30 | |

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

Feedback from the students during class committee meetings

Institute end semester feedback

**COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)**

**MODE OF CORRESPONDENCE (email/ phone etc)**

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ any other information regarding this course) will be done through their Webmail only. Conduct of course and sharing of course material will be done through MS Teams. Suitable platform/software tool will be chosen for the conduct of assessments and will be informed to the students.

2. Queries (if required) to the course teacher shall only be emailed to selvanmp@nitt.edu.

**COMPENSATION ASSESSMENT POLICY**

1. Attending all the assessments are MANDATORY for every student.

2. If any student is not able to attend any of the assessments (Scheduled Quiz of assessment 1 and 2 only) due to genuine reason, the student is permitted to attend the compensation assessment (CPA).

3. At any case, CPA will not be considered as an improvement test.

## ATTENDANCE POLICY

As directed by the Academic Office.

## ACADEMIC DISHONESTY & PLAGIARISM

➢ Copying from others during an assessment will be treated as punishable dishonesty.

➢ Zero mark will be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.

The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

## ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty.

## FOR APPROVAL

**Course Faculty** _____   **CC-Chairperson** Dr. S. Kayalvizhi   **HOD** Approved by HoD