Project Aim: Design, analyse and control of high voltage power systems

Objective:

- To analyse the operation of current high voltage grids with different power system devices and investigate stability
- To analyse the impact of distributed energy resources (DERs) integrations on the performance of the high voltage power grid
- To develop controllers to improve the performance of power systems

You will do a project in a group, but you will submit your portfolio, and final oral presentation individually. You will submit proposal and final demonstration in group. You will design a project and pose a question/problem hypothesis. The short description of the project is given below:

Description:

Modern power systems have grown larger and more geographically expansive with many interconnections between neighbouring systems. Conventional generation capacity is being replaced continuously by renewable generator (RG) units in order to reduce greenhouse gas emissions. RG plants are highly distributed and strongly dependant on changing weather conditions. Mechanical input energy for RG units cannot be directly controlled in the way as can for fossil fuelled generation plants. Significantly increasing the capacity from renewable energy requires a revision of the way power systems are designed, operated and controlled in order to accommodate these variable sources. Therefore, a thorough power flow and voltage stability analyses are required to ensure the reliability of power systems. Also, it is required to design and implement controllers to ensure desired performance from power system under a wide range of operating conditions.

The main objective of this project to analyse the power flow, stability and then design controllers to improve its performance. Firstly, you will design and analyse the power flow of power systems under different operating condition. Secondly you will simulate and analyse the stability of power systems during normal and faulted conditions. Finally, you will design a controller to mitigate their adverse impacts and enhance the stability limit. You will analyse the response of voltage, power and frequency.

Instructions:

You have the freedom to choose your own topic, with the following requirement.

- The project should be focused on power system analysis and design.
- The project should be at the transmission level as this subject mainly studies the transmission-level topics.

- The project should be based on a complete power system, including generator, transmission line, and load. This system should be a mesh system including at least 3 generators, 3 buses, and loads.
- Load flow is essential. Besides Load flow, the project should cover at least other 3 topics in the subject.
- Software: PowerWorld or PSSE

Example of projects (These topics have been selected based on industry consultations):

(i) Impact of renewable generation integrations on the performance of power systems

(ii) Voltage stability analysis with renewable generation

(iii) Impact of PV reactive power control on power systems

(iv) Variation of active power from generating plant in response to frequency

(v) Response of generating plants to setpoint changes in power systems

(vi) Impact of wind integrations on the performance of power systems

(vii) Analysis of plant response to system fault events in power systems

(viii) Impact of DFIG on State Voltage Stability of a power system

(ix) Impact of a Solar PV system on short-term voltage stability

(x) Impact of battery energy storage on stability of a power system – **Topic Chosen**

Tasks:

Week	Tasks (breakdown)
1	Understand the project requirements and form a group
2	Pick up a topic and discuss with lecturers to finalise it
3	Write up and submit the project proposal
4	Model and do the load flow
5	Finalise the single line diagram and model of the system
6	Complete the model and implement on software platform
7	Preliminary analysis and validation of developed model
8	Analyse the stability
9	Design a control technique
10	Analyse the performance of your control technique

| 11 | Finalise all results and verification |
| 12 | Complete the project |