ELG4125
Themes of Course Projects

Theme 1: Power System Modelling

Theme 2: Power System Analysis

Theme 3: Forecasting in Power Systems

Theme 4: Distribution System.

Theme 1: Power System Modelling

- In addressing power system modelling, three projects were designed:
- **Project 1:** Modelling of generation level of a typical power system.
- **Project 2:** Engaging with transmission level.
- **Project 3:** Modelling of high voltage transmission networks.

Project 1

Modelling of generation level of a typical power system

- The students are asked to find out the following.
  - Power generation technologies and their characteristics in terms of their start-up, operating cost, greenhouse gas emissions, and use of renewable and non-renewable resources
  - A list of the main generators in Ontario along with their generation technology and their sites.
  - The Thevenin's equivalent of generators from their specifications

Project 2

Engaging with Transmission Level

- The students are asked to report on the following:
  - Name the Transmission Network Service Provider in the State and explain its responsibilities.
  - Determine the electricity networks supplying Ottawa, and its single line diagram.
  - Type of the electrical conductors which are used for transferring electricity and their technical specifications.
  - Type of the transmission towers used with their technical specifications.
  - Derive π and T models of specified transmission lines in the network with their thermal capacities.
  - Technical specifications of transformers at a specified substation and derivation of their circuit models.
  - Given a typical load profile, for example a peak demand daily curve for the local city, derive the load model (P-Q constant model) based on typical power factors.

Project 3

Modelling of High Voltage Transmission Networks

- The students are asked to do the following:
  - The team selects one sub-area in Ontario and draws the single line diagram of the relevant transmission network (It is suggested that students use a suitable drawing software such as Auto-CAD for drawing the single line transmission network).
  - Students then complete tables related to the Branch Data, Generator Data and Load Data of their selected transmission network.

Theme 2
Power System Analysis

- Project 1: Economic Operation of a Power System.
- Project 2: Power Flow Study.
- Project 3: Fault Problem Study.
- Project 4: Voltage Stability Study.

Project 4
Economic Operation of a Power System

- The Ontario transmission system will be used as a case study and the students are asked to do the following:
  - List all existing generators with their minimum generation levels, maximum generation levels, and their incremental fuel costs.
  - Find the summer peak and winter peak of the load on the transmission system.
  - Find the economic dispatch of the load among generators.

Project 5
Power Flow Study

- The students will write their own code for numerical solution of the IEEE 14-bus case study using the Gauss-Seidel method.
- The students will perform the power flow study for a meshed transmission network. Then, they perform a power flow study for a radial distribution network. By doing these, students learn that although the software does the power flow study for them, but they need to put in many component parameters and network data.
- The students explore the difference between a transmission network and a distribution network.
- The students should repeat the power flow study for some specific contingencies and report on the robustness of the system.

Project 6
Fault Problem Study

- Students are introduced to three different approaches for fault studies.
  - Firstly, they apply the analytical approaches to a simple radial network for finding the short circuit currents.
- Secondly, model a typical industrial system. The system given in the following reference might be used as the case study and the students were asked to do the following [*IEEE recommended practice for industrial and commercial power Systems analysis*]
- Find the ANSI, IEEE, VDE, and IEC standards which are related to the short-circuit studies.
- Model the example system using one of the available softwares. Report the steady state condition of the system including the voltage and line active and reactive powers.
- Find the weak points of the system in case of three phase fault.
- Considering the four major short circuits, which one can cause the worst condition in terms of line over loading if they occur at a specific bus.

Project 7
Stability Problem Study

- This is an optional project, to start please see these resources or more to define the project:
  - C. W. Taylor, N. J. Balu and D. Maratukulam “Power system voltage stability”, Electric Power Research Institute – Power System Engineering, McGraw-Hill, 1994.
  - T. Van Custem and C. Vournas, “Voltage stability of electric power systems”, Springer, 2008.
  - P. Kundur, “Power system stability and control”, 1994.

Theme 3
Forecasting in Power Systems

- **Project 8:** As a project on this topic, students are asked to forecast the Ontario transmission system load for the periods of 2 years and 10 years in the future.
- Start with exploring different sources to list all available methodologies in load forecasting. Then, find the positive points and negative points of each methodology and rank them based on these points.
- Finally, choose the best method of load forecasting for the Province of Ontario.

Theme 4
Distribution System

- **Project 9:** Sizing a Transformer for an Industrial Plant.
- **Project 10:** Designing a Distribution Network for a New Residential Development in Ottawa.
- **Details:** To be determined from the Instructor!