ATSC 313 - Module Learning Goals – **Hydro Theme**

Hydro A: Run-of-river hydro plant selection

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as electricity prices from published sources.
Choose a re-analysis dataset and **generate** your own weather maps.
Interpret weather maps to **determine** precipitation at key sites.
Combine precipitation data and electricity prices to **estimate** net revenue for each site.
Compile info on costs for plant construction, maintenance, down time, etc.
Debug and **check** your work by **comparing** against a known generation site.
Rank the sites from best to worst and **select** the best site.
Justify your selection in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

Hydro B: Hydro dam management for a predicted heavy rain event

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts, and **interpret** them.
Design and **Code** a computer hydrologic **model** to calculate inflow and outflow to/from a reservoir
Select a precipitation forecast that best represents the approaching weather.
Make assumptions as needed to enable your decision making.
Weigh/contrast the issues to maximize both revenue and dam safety.
Run and **debug** your model for the specific weather and hydroelectric facility.
Decide how much water to release from the reservoir.
Justify your decision in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

Hydro C: Financial report for a run-of-river hydro plant

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts, and **interpret** them.
Modify your model from Hydro B' to account for snowmelt.
Apply your computer model for runoff from rain and snowmelt.
Analyze forecast skill and **modify** the model to correct for biases.
Determine the time lag between precipitation and runoff.
Incorporate both volume flow rate and velocity in your **estimation** of power production.
Anticipate weather-related risks and hazards due to exceptional rainfall.
Select the best revenue estimate.
Justify your decision in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

Hydro D & Hydro Midterm Exam

By the end of this module, you will be able to ...

Draw on your knowledge of precipitation and hydro-electric operations to **analyze** new situations.
Recommend appropriate **decisions** and **actions** considering all the relevant factors.

ATSC 313 - Module Learning Goals – **Wind Theme**

Wind A: Severe weather damage to wind farms

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts.
Interpret satellite images and weather maps to estimate thunderstorms locations and evolution.
Analyze soundings to **determine** atmospheric stability and thunderstorm indices.
Compile synoptic, mesoscale, and storm winds to **create** a mental picture of the situation.
Compose a report summarizing the events and analyzing the role of the atmosphere.
Critique your answer based on the actual outcome and thoughts by experts.

Wind B: Selection of location for a new wind farm

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as wind climatology, topography.
Interpret maps of wind potential.
Analyze the effects of ridges, valleys, and isolated hills on wind-energy potential.
Describe how the boundary layer affects hub-height wind speed.
Compare the advantages and disadvantages of the three potential sites.
Compose a report **recommending** the best wind-farm location.
Justify your recommendation.
Critique your answer based on the actual outcome and thoughts by experts.

Wind C: Wind power statistics, probability forecasting and energy trading

By the end of this module, you will be able to ...

Determine what weather and wind farm info you need to address this issue.
Acquire available data such as wind probability forecasts and spot energy prices.
Calculate frequency distributions for wind speed and wind power.
Fit a Weibull distribution to the wind speed data.
Explain the difference between power curves for wind turbines vs. wind farms.
Predict the expected annual power production for the wind farm.
Interpret probabilistic forecast graphs.
Decide whether to sell the anticipated excess power, based on the cost/loss ratio for your wind farm.
Explain your calculations and **justify** your recommendation to sell power or not.
Critique your answer based on the actual outcome and thoughts by experts.

Wind D & Wind Midterm Exam

By the end of this module, you will be able to ...

Draw on your knowledge of wind and wind-farm operations to **analyze** new situations.
Recommend appropriate **decisions** and **actions** considering all the relevant factors.

ATSC 313 - Module Learning Goals – **Solar Theme**

Solar A: PV solar panel design for a Vancouver homeowner

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data such top-of-atmosphere incoming radiation and cloudiness climatology.
Critique the accuracy of various radiometers.
Code a program to **calculate** theoretical irradiance, and **compare** with measured irradiance.
Design the optimum PV system for the home.
Recommend to the homeowner whether a PV solar panel should be installed.
Critique your answer based on the actual outcome and thoughts by experts.

Solar B: International site selection for a utility-scale solar power facility

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data including Global Horizontal Irradiation climatologies and PV specs.
Compare irradiation data at different international sites.
Design optimum solar panel spacing.
Calculate PV module efficiency and energy yield over a ten-year lifespan, including aging issues.
Consider other factors such as distance to transmission lines and inefficiency when hot.
Decide which site is optimum.
Justify your decision.
Critique your answer based on the actual outcome and thoughts by experts.

Solar C: Farm-scale solar design, energy storage, and renewable-energy education

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data including Global Horizontal Irradiation climatologies and PV specs.
Identify cloud types by the visual appearance, and **relate** them to expected irradiance.
Interpret and **compare** satellite images and NWP forecasts of clouds.
Relate cloudiness to synoptic weather map features.
Explain how different cloud types cause different attenuation of insolation
Calculate energy yield & revenue, and **determine** the payback period for installing solar panels.
Estimate the effects of climate change on solar panel viability in the future.
Critique your answer based on the actual outcome and thoughts by experts.

Solar D & Solar Midterm Exam

By the end of this module, you will be able to ...

Draw on your knowledge of irradiation and solar power to **analyze** new situations.
Recommend appropriate **decisions** and **actions** considering all the relevant factors.

ATSC 313 - Module Learning Goals – **Synthesis Theme**

Synthesis A: Scientific, social & political issues on electric-market deregulation

By the end of this module, you will be able to ...

Compare the advantages and disadvantages of a deregulated electricity market.
Compare the relative values of different generation sources, and their vulnerabilities.
Estimate the effects of reliability, dispatchability, transmission, trading, tariffs, etc.
Relate correlated fluctuations in hydro, wind, and solar generation to passage of lows and fronts.
Explain alternatives.
Compile the information and **write** a briefing paper that is clear, concise, jargon-free.
Recommend and **justify** the best course of action.
Counsel the politicians on the issues.
Critique your answer based on the actual outcome and thoughts by experts.

Synthesis B: Write an article for a general-science website on the future of the electric grid in year 2050

By the end of this module, you will be able to ...

Determine what information you want to focus on in this article for the public.
Contrast electric generation growth with population growth, and **project** vulnerabilities.
Compile factors such as home vs. utility scale, smart electric grid, smart meters, energy shortages.
Propose your vision for the future, and be **creative**.
Justify your predictions.
Critique your answer based on the actual outcome and thoughts by experts.