**Task Breakdown**

**1. Z-Plane Plot:**

* Create a visual plot of the z-plane, including the unit circle.
* Allow users to:
  + Place zeros and poles by clicking on the plot.
  + Drag zeros and poles to adjust their positions.
  + Delete zeros or poles by clicking on them.
  + Clear all zeros, poles, or both using buttons.
  + Optionally add conjugates for complex elements using a checkbox.

**2. Frequency Response Plot:**

* Generate a plot displaying the frequency response of the designed filter.
* Include separate graphs for magnitude response and phase response.

**3. Filter Application:**

* Enable users to apply the designed filter to a lengthy signal (minimum 10,000 points).
* Simulate real-time filtering:
  + Display a graph of the signal's time progress, revealing only a portion at a time.
  + Display a graph of the filtered signal's time progress as filtering occurs.
  + Provide a slider to control the filtering speed/temporal resolution (e.g., 1-100 points per second).
* Allow users to input a real-time signal by moving the mouse within a designated area:
  + Map mouse coordinates (x or y) to the input signal.
  + Reflect mouse speed in signal frequency (faster motion generates higher frequencies).

**4. All-Pass Filter Features:**

* Implement a library of all-pass filters:
  + Display zero-pole combinations and phase responses for each filter.
  + Allow users to select and add filters to the original design.
* Provide a custom all-pass filter option:
  + Enable users to specify a custom "a" value.
  + Calculate and integrate the corresponding phase response into the library.
* Allow users to enable/disable added all-pass filters using a drop-down menu or checkboxes.

The UI for designing the all-pass filter can have two main sections:

**1. All-Pass Filter Library:**

* List of predefined filters:
  + Each filter is listed with a descriptive name or identifier.
  + Clickable thumbnails showing the zero-pole plot of each filter.
  + Hovering over a thumbnail displays the corresponding phase response in a tooltip or overlay.
  + Clicking on a thumbnail selects the filter for adding to the current design.
* Filter details panel:
  + Once a filter is selected, this panel displays detailed information:
    - Transfer function equation or difference equation representation.
    - Numerical values of specific parameters like "a" coefficient.
    - Larger plot of the zero-pole configuration and phase response.
    - Optional: Frequency response plot demonstrating the filter's effect on magnitude and phase.
* Search and filter options:
  + Allow users to search for specific filters by name or keyword.
  + Provide filters based on desired phase response characteristics (e.g., linear, minimum delay).

**2. Custom All-Pass Filter:**

* “a” coefficient input:
  + A text field or slider where users can input the desired "a" value.
  + Real-time update of the phase response based on the entered value.
* Visualization panels:
  + Update the zero-pole plot and phase response based on the custom "a" value.
  + Optionally show the frequency response of the custom filter.
* Add to Design button:
  + Once the user is satisfied with the custom filter, they can click a button to add it to the current design alongside the pre-defined filters.

**3. Additional UI elements:**

* Enable/disable checkboxes: For each added all-pass filter, provide a checkbox to easily enable or disable its effect on the overall filter response.
* Information panel: Briefly explain the concept of all-pass filters and their role in correcting phase shifts.
* Help button: Link to a more detailed explanation of all-pass filters and their design considerations.
* By combining these elements, you can create a user-friendly UI for designing and incorporating all-pass filters into your Z-plane filter application. Remember to keep the interface intuitive, visually appealing, and informative to empower users of all skill levels to leverage the power of all-pass filters.