Work Plan and Methodology:

Phase-I:

1. **Review of Literature**
   - Chapter 1 - Introduction
   - Chapter 2 - Background and Significance of L-Ascorbic acid derivatives
   - Chapter 3 - Background and Significance of fuel cell

Phase-II:

2. **Synthesis of L-ascorbic acid derivatives:**
   - Example for the Synthesis of L-ascorbic acid derivatives
   
   Synthesis of L-ascorbic acid derivatives 5,6,mono-\(O\)- cyclohexylidene-3-methil L- ascorbic acid, 2-O-[(3-Aminopropyl) phosphinoxy]-L-ascorbic acid LAAP,

3. **Characterizations of L-ascorbic acid derivatives:** the synthesized L-ascorbic acid derivatives were characterized using suitable characterization techniques NMR, IR, GCMS, and XRD.
   - Chapter 4 - Synthesis and characterization of L-Ascorbic acid derivatives

Phase-III:

4. To study cyclic voltammetry for electrooxidation of L-ascorbic acid derivatives.

5. To perform fuel cell experiment using L-ascorbic acid derivatives as a fuel.
   - Chapter 5 - Electrooxidation properties of L- ascorbic acid derivatives

Phase-IV:

6. **Report writing**
   - Chapter 6- Conclusion

Example for the Synthesis of L-ascorbic acid derivatives

Scheme 1

Synthesis of L-ascorbic acid derivatives 5, 6, mono-\(O\)-cyclohexylidene-3-methyl L-ascorbic acid:-
1) The preparation of a mono-\(O\)-cyclohexylidene derivative of \(L\)-ascorbic acid is described.

2) The new compound is shielded by the cyclohexanone group at C-5 and C-6 of the ascorbic acid molecule, while the double bond between C-2 and C-3 is kept intact.

3) The double bond of the new derivative is more resistant to oxidation than its parent compound.

4) Ascorbic acid is easily regenerated by mild acid hydrolysis.

5) The new derivative facilitates the synthesis of \(^{14}\)C-labelled vitamin C.

Scheme II

2-Chloro-[1,3,2]oxazaphosphinane 2-oxide (3). To a solution of 3-amino-1-propanol and triethylamine in dichloromethane a solution of phosphorus oxychloride was added dropwise at 5\(^\circ\)C for 2 h. After filtration to remove triethylamine hydrochloride salt, the filtrate was dried over MgSO\(_4\) followed by filtration and concentration in vacuum. The residue was precipitated by addition of toluene to give 2-chloro-[1,3,2]oxazaphosphinane 2-oxide 4 as a white solid.

2-O-[(3-Aminopropyl)phosphinoxy]-\(L\)-ascorbic acid LAAP, 2). To a suspension of 5,6-isopropylidene-L-ascorbic acid and triethylamine in dichloromethane (20 mL), 2-chloro-[1,3,2]-oxazaphosphinane 2-oxide in dichloromethane was added dropwise at 5\(^\circ\)C for 1 hrs. After the addition, the reaction mixture was further stirred at room temperature for 1 day. The mixture was washed with an aqueous phosphoric acid solution, and then the organic layer was separated and
dried over anhydrous sodium sulfate followed by decoloration with activated charcoal. The solution was filtered and concentrated under reduced pressure and used in the following hydrolysis reaction without further purification. The residue was dissolved in 30 mL of water and stirred at 50 °C for 3 hrs. Then, 150 mL of isopropanol was added to the solution to precipitate LAAP as a white solid. The product was filtered and dried.