**Methodology & Work Plan:-**

**Methodology:-**

The glass is an important system both from scientific and technological points of view the separation of crystalline phase from glass phase under regular heat treatment is interning from both physical & chemical point of view as well as the resulting modification of glass properties.

It is planned to synthesize glass by altering the composition in the high temperature furnace. Thus prepared glass anedil for 4-6hours in order to get uniformity of the structure. The glass of required shape is cut & made use in the measurements.

**1.Glass Preparation:-**

Glasses will be prepared by conventional melt quench technique. It involves batch preparation, grinding or mixing, calcinations, melting, quenching and annealing. For effective mixing and reaction among different constituents, the reactants were thoroughly ground in a mixer or aged mortar and subjected to different heating steps depending on the type of glass, prior to final melting and quenching process. During calcinations the nitrates, carbonates, sulphates chlorides etc. of constituent elements transformed into their oxides. Alumina crucibles were used for calcinations and melting purposes.

A binary, ternary and multi-component glass systems were prepared using analytical grade compounds like NaNO$_3$, (NH$_4$)$_2$HPO$_4$, NH$_4$H$_2$PO$_4$, H$_3$BO$_3$, K$_2$CO$_3$, CacO$_3$, Al$_2$O$_3$, ZnO,

CusO$_4$, CoCl$_2$ etc. The purity, make and the role of the particular component is mentioned in the Table.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the chemical</th>
<th>Make</th>
<th>% Purity</th>
<th>Role in the glass system</th>
</tr>
</thead>
</table>

**Table: Raw materials used for experimental procedure.**
<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Brand</th>
<th>Purity</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SiO₂</td>
<td>SD Fine</td>
<td>99</td>
<td>Glass former</td>
</tr>
<tr>
<td>2</td>
<td>(NH₄)₂HPO₄</td>
<td>SD Fine</td>
<td>98</td>
<td>Glass former</td>
</tr>
<tr>
<td>3</td>
<td>NH₄H₂PO₄</td>
<td>Merck</td>
<td>99</td>
<td>Glass former</td>
</tr>
<tr>
<td>4</td>
<td>NaNO₃</td>
<td>SD Fine</td>
<td>99.5</td>
<td>Network modifier</td>
</tr>
<tr>
<td>5</td>
<td>Na₂CO₃</td>
<td>SD Fine</td>
<td>99.5</td>
<td>Network modifier</td>
</tr>
<tr>
<td>6</td>
<td>H₃BO₃</td>
<td>Merck</td>
<td>99.8</td>
<td>Network modifier &amp; Glass former</td>
</tr>
<tr>
<td>7</td>
<td>K₂CO₃</td>
<td>SD Fine</td>
<td>99.9</td>
<td>Network modifier</td>
</tr>
<tr>
<td>8</td>
<td>ZnO</td>
<td>RL Fine</td>
<td>99</td>
<td>Network modifier</td>
</tr>
<tr>
<td>9</td>
<td>Al(NO₃)₃</td>
<td>RL Fine</td>
<td>99</td>
<td>Network modifier &amp; Glass former</td>
</tr>
<tr>
<td>10</td>
<td>CuSO₄.6H₂O</td>
<td>Merck</td>
<td>99%</td>
<td>Colorant</td>
</tr>
<tr>
<td>11</td>
<td>Li₂CO₃</td>
<td>Loba</td>
<td>99%</td>
<td>Network modifier</td>
</tr>
<tr>
<td>12</td>
<td>CoCl₂.6H₂O</td>
<td>Merck</td>
<td>99%</td>
<td>Colorant</td>
</tr>
<tr>
<td>13</td>
<td>CaCO₃</td>
<td>RL Fine</td>
<td>99</td>
<td>Flux</td>
</tr>
</tbody>
</table>

2. **Batch preparations:-**

The glass composition was weighed according to weight percent to give a 25gm. The quantity of each constituent will determined for each batch depending on the composition of glass.

3. **Studies of Phosphate Glasses:-**

We plan to prepare and study the following compositions of Phosphate Glasses.

1. To Study the effect of addition of (Alkali) Sodium Oxide on Phosphate glass:

   \[ X\text{Na}_2\text{O} - (100-x) \text{ P}_2\text{O}_5 \]

2. To Study the effect of addition of B₂O₃ on sodium Phosphate glass with respect to thermal,
mechanical, optical & chemical durability of glass -

$$X \text{B}_2\text{O}_3 - (1-x) \text{Na}_2\text{P}_2\text{O}_5$$

3. To study the effect of addition of Calcium Oxide (alkaline earth metal oxide) on sodium Phosphate glass-

$$X \text{CaO} - 30 \text{Na}_2\text{O} - (70-x) \text{P}_2\text{O}_5$$

4. To study the mixed alkali effect (MAE) on Phosphate glass -

$$X \text{Li}_2\text{O} - (30-x) \text{K}_2\text{O} - 10 \text{ZnO} - 60\text{P}_2\text{O}_5$$

5. To study the effect of mixed alkali effect (MAE) and transition metal ion (TMI) effect on the properties of Phosphate glass

$$X \text{Li}_2\text{O} - (30-x) \text{K}_2\text{O} - 10 \text{ZnO} - (60-y) \text{P}_2\text{O}_5 - y\text{CuO}$$

The phosphate glass with different compositions has been synthesized by melt-quench method. Optimization of process parameters for calcinations, melting and annealing have been discussed.\(^{(33)}\)

The detailed studies on Phosphate Glasses with the various compositions. To see the effect of Variation of Calcium oxide, the effect of mixed alkali effect and transition metal ion on the thermal, electrical mechanical, structural, optical and chemical properties of these phosphate glasses have been investigated and discussed. This chapter explains the results and discussion on density, molar volume, optical, thermal analysis, electrical conductivity, chemical durability/degradation, structural aspects of phosphate glasses are studied.

3. **Characterization of glasses:**

The synthesized glass materials will be characterized by

**Following techniques**

1) Density & Molar Volume
2) UV- Ultra Violet Spectroscopy.
4) TGA- Thermal Gravimetric Analysis.
5) DTA- Differential Thermal Analysis.
6) XRD- X-Ray Diffraction.
7) SEM- Scanning Electron Microscopic Study.
8) TEM- Transmission Electron Microscopic Study.
9) Impedance Analyses. It is planned to study the kinetics of the reaction & the energy of activation.
10) Thermal Expansion.

**Work Plan:**

1) First six months literature review.
2) Second six months practical work, preparation of glass sample.
3) Third six months studies of glass samples.
4) Last six months characterization of prepared glass sample, thesis writing & submission.