Course Syllabus:
Aluminum Crucible Furnace Practices

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CEUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-211</td>
<td>0.6 CEUs</td>
</tr>
</tbody>
</table>

**Course Introduction**
Basic aluminum furnace and crucible operations, including construction, operations and maintenance practices for both electric and fuel-fired aluminum crucible furnaces.

**Benefits to Taking the Course**
This course offers both practical and theoretical knowledge for those operating aluminum crucible furnaces. Participants of this course will leave with the knowledge and/or skills to select an appropriate aluminum crucible for their needs, operate and maintain aluminum crucible furnaces, store and handle crucibles to maintain the life of the crucible, describe refractory installation practices and how to avoid premature deterioration of the refractory, monitor and manage heating systems and burners, and optimize crucible furnace operations so that usage at any stage is efficient.

**Learning Outcomes**
After completing this course, participants should be able to:
1. Describe aluminum crucibles and furnaces.
2. Identify maintenance best practices for aluminum crucibles, including storage, handling, cleaning and safety.
3. Describe aluminum furnace refractory materials (linings and crucibles), their installation, and how to avoid deterioration.
4. Identify proper aluminum crucible furnace operations.
5. Describe the components of crucible furnace heating systems and how to optimize them.
6. Identify temperature measurement tools and controls.
7. Identify aluminum crucible furnace optimization methods through the use of energy efficiency practices.

**Course Topics**
- Course Introduction
- Crucibles
  - Overview/Use/Types
  - Materials
  - Selection
  - Storage and handling
  - Installation
- Crucible Maintenance
  - Cleaning
  - Crucible defects and premature failure
  - When to change your crucible
- Furnaces
  - Furnace Types (lift-out, tilting, electric resistance)
  - Operations
    - Start up and general operations
    - Safety
    - Charging
    - Oxidation
    - Melt treatment, fluxing
- Refractory Materials
- Causes of deterioration
  - i. Thermal shock
  - ii. Carbon deposits
  - iii. Mechanical abuse
  - iv. Metal penetration
- Replacement and Repair of Furnace Materials
- Electric Resistance Furnaces
  - Heating systems
    - Types (Fuel fired, Recuperation, Electric Resistance)
    - Combustion by-products and control methods
    - Emissions and environmental regulations
    - Optimizing burner combustion
  - Metal temperature controls
    - Pyrometers (calibration)
    - Temperature controllers
      - i. Digital read out
      - ii. Red-light, green-light
      - iii. Set temperature range (over/under) for pouring temperature
      - iv. Best practices for controlling and monitoring thermocouple
      - v. Placement and maintenance
  - Optimization
    - Measures to maximize thermal efficiency
    - What to watch for to maintain efficient heat transfer
    - Scrap rate reduction
    - Optimization of crucible furnace practices

### Instructional Methods:
1. Class discussion
2. Group activities
3. Individual problem solving
4. Case studies

### Assessment Methods:
- Facilitator Q&A
- Group activity review
- Case study debrief and discussion
- Group presentations and feedback
<table>
<thead>
<tr>
<th><strong>Course Prerequisites:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended: <em>Aluminum 101</em> and <em>Aluminum Melting 201</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Attendee Requirements to Earn CEUs:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Present at least 5.5 hours of the total 6 hours of instructional time (90%).</td>
</tr>
<tr>
<td>2. Active participation (can include asking questions, communicating with other attendees during and taking part in group activities, providing responses during whole class or group discussions).</td>
</tr>
<tr>
<td>3. Successful achievement of learning outcomes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Who Should Attend?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The target audience for this course consists of individuals responsible for or involved with aluminum crucible melting operations and/or aluminum crucible maintenance and handling in the foundry. This may include:</td>
</tr>
<tr>
<td>- Melters</td>
</tr>
<tr>
<td>- Supervisors</td>
</tr>
<tr>
<td>- Technicians</td>
</tr>
<tr>
<td>- QA Managers</td>
</tr>
<tr>
<td>- Foundry managers</td>
</tr>
</tbody>
</table>