**Project Proposal for Ph.D.**

### Project Details

<table>
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<tr>
<th>Project Title</th>
<th>Laser and Advanced Arc Welding of High-Strength Steel and Aluminium Alloys for Similar and Dissimilar combinations For Automotive and Naval Applications</th>
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This proposal will focus on investigating the possibility and potential of steel-to-steel, aluminium-to-aluminium and steel-to-aluminium laser-welded or arc welded joints. In order to reduce the formation of IMCs, this project will focus on using high-entropy alloys (for high mixing entropy), as filler material, to promote the formation of single-phase solid solution structures, which would have significant advantages in inhibiting the formation of Fe-Al IMCs in the welding of Al/steel joints. The filler materials can be used in the form of filler wire or powder to enhance the weld properties. Therefore, in-depth investigations are needed to improve the weld quality, including mechanical, metallurgical and microstructural properties.

This project is focused on (i) in-depth understanding the material science and elemental behaviours for selecting and fabricating suitable filler wire or powder (use of high entropy powders consisting of Fe, Co, Cr, Ni, Mn, Zn or Si) to increase weld joint quality; and (ii) digital twin enables modelling and simulation for adapting the welding process for high volume manufacturing for automotive and naval applications, (iii) understanding the microscale structure of these weldments and in case of failures, the root cause analyses through detailed structural characterization, and (iv) to correlate the mechanical strength of the welded joints with the observed structure and identifying mitigation strategies to improve the strengths.

### Ph.D. Supervisors

<table>
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<tr>
<th>Role</th>
<th>Name of Faculty</th>
<th>Academic Unit in IITD/Institute/University</th>
<th>Email ID (Official)</th>
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</thead>
<tbody>
<tr>
<td>Supervisor 1</td>
<td>Dr Abhishek Das</td>
<td>Mechanical Engineering</td>
<td><a href="mailto:abhi@mech.iitd.ac.in">abhi@mech.iitd.ac.in</a></td>
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<td>Supervisor 2</td>
<td>Dr. Ayan Bhowmik</td>
<td>Mater Sci and Engg</td>
<td><a href="mailto:abhowmik@iitd.ac.in">abhowmik@iitd.ac.in</a></td>
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### Project requirements (Student qualifications, experience required, etc)

*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)*

- Experience of welding and exposure to computer simulation for digital twin.
- Experience and understanding of metallurgical behaviours of materials.

### Source of fellowship/funding

*(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)*

SERB funded SRG Project / Own Fellowship

### Role of Faculty Members involved:

| Supervisor-1 (Dr Abhishek Das) | • Providing guidance on welding for high-volume manufacturing using laser welding and advanced arc welding processes  
 • Providing guidance for modelling and simulation studies for digital twin-enabled solutions |
| Supervisor-2 (Dr Ayan Bhowmik) | • Providing guidance on microstructural and mechanical property characterization  
 • Providing guidance on post-processing treatment following welding |