Proposal for announcing seat under the Institute Internship Program

(separate form to be filled for seat under Institute funding and project funding)

1. Name of faculty member proposing: **Jyotirmaya Kar**
2. Department/Centre: **Metallurgical and Materials Engineering**
3. Topic on which work is proposed: **Resistance spot welding of interstitial free steel sheets.**
4. Preferred period of internship (after May 20th): **Between June 2024 to July 2024**
5. Qualification of student (branch/semester of study): **Metallurgical and materials engineering, Mechanical Engineering, Manufacturing Engineering, Plastic Engineering,**
6. Brief description of work (300-500 words):

Interstitial-Free (IF) steel is one of the formable steels commonly used in auto bodies due to excellent deep drawability, owing to its ultralow carbon (usually less than 0.005 wt. %) and nitrogen (usually less than 0.005 wt. %) contents. Moreover, in these steels, microalloying of titanium, niobium, and vanadium is done in order to achieve optimum formability and also to compensate for the loss in strength due to their ultralow carbon content. Other properties of these types of steels extending their application in the automotive industry are their stretcher-strain pattern inexistence and antiaging property due to the negligible amount of solute C and N atoms. Furthermore, the low yield strength of these steels leads to the disappearance of surface deflection (orange peel effect) at the outer face of the autobody. Therefore, due to these distinct characteristics of IF steels, they are frequently used as rear and front door inners, side panels, spare wheel wells, oil pans, and rear floor pans.

Resistance spot welding (RSW) is the most widely used process in sheet metal joining for making autobody, electronic industries, home applications (like refrigerators), and rail vehicles. About 2000 to 5000 resistance spot welds are used in a typical modern automobile. The most important advantages of the RSW process in contrast to other welding processes, such as gas tungsten arc welding, laser beam welding, and friction stir spot welding, which make it possible to be used widely for manufacturing the structures with complex geometry and high mechanical strength in the automotive industry, are high operating speed (low process time), no requirement for consumables (e.g., filler metals), high productivity with low cost, possibility of joining thin sheets together, and simplicity of operation or automation.

In RSWs, optimization of welding parameters ensures the formation of spot welds with desirable geometry and size, which is critical for satisfactory mechanical performance. Three distinct parameters affecting the quality of resistance spot welds are the (1) weld FZ size, (2) mechanical behavior of WN, and (3) failure mode of spot welds. Moreover, it can be noted that welding current and welding time are the most important factors affecting the amount of generated heat and spot weld quality. Regarding the same, limited research has been carried out on IF steels RSWs. Besides, the role of the microstructure and phase formation in the heat-affected zone (HAZ) and FZ, and the microstructure transition from the base metal (BM) to the FZ on the mechanical response of the welds, has not yet been studied

in details. Though resistance spot weld processing of IF steel is known within the scientific community, RSW metallurgy of the steel (the links between the microstructure, microstructure transition from the BM to FZ, and mechanical responses of the welds) needs to be established. Therefore, the aim of this work is an in-depth understanding of the RSW metallurgy of IF steels, a study that is lacking in previous research. Furthermore, the microstructure, geometry, mechanical properties, and failure mode of the resistance spot welds of galvanized IF steels under various welding conditions (different welding currents and welding times) will be evaluated and analyzed, followed by optimization of the welding parameters.

7. Expected learning of student (upto 100 words):
   - → Hand on training operating various equipment such as pneumatic resistance spot welding machine, High resolution microscopes, diamond cutter, polishing machine, Microhardness and universal testing machine (Instron).
   - → Metallographic techniques such as sample preparation, polishing, etching and image capture and analysis.
   - → Mechanical testing procedures such as tensile testing and hardness measurements.

8. Nature of work: **(Experimental)**:
   - → Student will fabricate the RSW joints using the spot-welding machine in the department
   - → Student will to carryout detailed microstructural study of the fabricated joints using the laboratory facility (polishing and microscopes)
   - → Student will evaluate various mechanical properties (shear tensile, cross tensile and microhardness) of the fabricated joints

9. If the seat is under project sponsored category: **No**
   a) If yes, number of seats announced:
   b) Name and ID no. of project from which stipend is chargeable

Jyotirmaya Kar

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Metallurgical and Materials Engineering

Note:

a) Proposing faculty member needs to be available at the Institute during the period internship is offered
b) No extra space or funding than the stipend will be provided by the institute for this purpose

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