

Seminar Title	: Experimental Study of Thermal and Frictional Characteristics of Solar Air Heater using Impinging Jets with Modified Absorber and Jet Plates
Speaker	: Chinmaya Mund (Rollno : 518me1019)
Supervisor	: Dr. Sushil Kumar Rathore
Venue	: Seminar Hall (Mechanical Engineering Department) : ME-001
Date and Time	: 25 Oct 2024 (9:30 AM)
Abstract	: This study concentrates on solar air heater with impinging jets incorporated with modifications to the absorber and jet plate to improve efficiency. Five objectives were chosen and completed. For the first objective, an experimental setup of an impinging jet solar air heater (IJSAH) was developed to study its thermal and frictional characteristics. The jet plate was modified by drilling jet holes up to 100%, 80%, and 60% of the whole length, and the diameter of the jet hole considered were 3, 6, and 9. It was concluded that IJSAH with reduced length of drilled section developed similar performance to IJSAH having completely perforated jet plate while developing significantly lower friction factor. In the second objective, the thermal performance of the IJSAH was improved by using wire mesh of three different sizes. The wire mesh sizes were 12.7×12.7 mm (0.5×0.5 inch), 38.1×38.1 mm (1.5 × 1.5 inch), 76.2 × 76.2 mm (3×3 inch) with nozzle diameter (D_j) equal to 3 and 6 mm and Reynolds number (Re) ranging from 4913 to 13103. It was concluded that a wire mesh having a mesh size equal to 38.1×38.1 mm with $D_j = 6$ mm should be employed for optimum performance.

For the third objective, an experimental study was conducted to analyse the thermal and frictional attributes of an IJSAH with an absorber plate having stepped transverse ribs with varying pitch and size. Two ribs of dimension 2×4 cm (R1) and 4×6 cm (R2) were tested. The pitch (p) between ribs was 2, 4, and 8 cm, with Re varying from 4913 to 13103. The jet hole diameter considered were 3, 6, and 9 mm. It was summarised that R1 rib with $p = 4$ cm at $Re=11465$ demonstrated better thermal characteristics based on detailed investigation. For the fourth objective, an experimental study on the effect of shortening of jet plate perforation length on the thermal and frictional performance of an impinging jet solar air heater with ribs (RIJSAH) was conducted. The jet span length (JSL) was shortened to 80% and 60% of the total length, while the D_j considered were 3, 6, and 9 mm. In conclusion, it was recommended that RIJSAH be fabricated with $D_j = 6$ mm and 60% JSL to achieve well-optimised thermal performance. For the final objective, the thermal and frictional attributes of ribbed IJSAH having a jet plate modified with protruded circular nozzles (PCN) were estimated. The inside diameter considered for the protruded nozzles were 3, 6, and 8 mm, while the thickness of these nozzles was kept constant at 2 mm. Subsequently, the performance of PCN IJSAH with a reduced span of the jet plate was studied. The jet plate span length (JSL) was modified from 100% ($L=1400$ mm) to 80% (1120 mm) and then 60% (840 mm). It was concluded that PCN RIJSAH, with a reduced span of jet plate length, developed better thermal performance relative to the friction factor generated.