**ALL ARE WELCOME**

**M.S SEMINAR TALK**

**Title of the seminar:** Experimental Study on Heat Transfer Enhancement in Accelerated Fluid Flow through High Permeability Porous Media.

**Speaker:** Mr Sandeep Kumar, ME22S038
**Biography of the Speaker:** MS Scholar, Dept. of Mechanical Engineering

**Date and time**: 16-January-2026 (Friday) and 3:00 p.m.

**Venue:** https://meet.google.com/hqv-tecn-pec

**Abstract:**
This experimental study investigates convective heat transfer enhancement and the associated hydraulic performance of forced air flow through rectangular ducts with varying aspect ratios. Two duct configurations of 140 mm length and 40 mm width were examined, with a constant inlet height of 40 mm. The first configuration had a uniform cross-section (AR = 1), while the second featured a reduced outlet height, forming a converging duct with an aspect ratio of AR = 2.7. A uniform surface heat flux of 1000 $W/m^2$ was applied to evaluate thermal performance under controlled conditions. To enhance heat transfer, high-permeability wire-mesh porous inserts made of aluminium and stainless steel were employed. The porous media had high porosity values in the range of 0.90–0.92, with Permeabilities of $5.67 \times 10^{-7}$ $m^2$ for aluminium and $1.54 \times 10^{-7}$ $m^2$ for steel. Experiments were conducted over a Reynolds number range of 3000–8000, and key parameters such as local and average Nusselt numbers, average surface temperature, and pumping power were measured. The results show that the average Nusselt number increases monotonically with Reynolds number for all configurations. The AR = 2.7 duct exhibits 13–36% higher average Nusselt numbers than AR = 1 under smooth duct conditions. The introduction of porous media further enhances heat transfer, with aluminium and steel inserts increasing the average Nusselt number by approximately 44% and 26%, respectively. Aluminium porous media consistently outperform steel by 10–16%, and the combined effect of aluminium porous inserts and higher aspect ratio yields a maximum enhancement of approximately 87% relative to the smooth AR = 1 duct. Correspondingly, the average surface temperature decreases with increasing Reynolds number. Aluminium and steel porous media reduce surface temperature by approximately 31–34% and 16–25%, respectively, while increasing the aspect ratio provides an additional reduction of about 10–13%. The enhanced thermal performance is accompanied by higher pumping power, particularly for the AR = 2.7 duct and porous configurations, due to increased flow acceleration and hydraulic resistance. Overall, the study demonstrates that high-porosity porous media combined with optimized duct geometry can achieve significant heat transfer enhancement while maintaining a reasonable thermo-hydraulic balance for advanced thermal management applications.