Abstract

The present work represents experimental and numerical work to study the natural, transient, mixed and forced convection heat transfer from a cube which represent an electric module fixed in a relatively long duct tilted at different angles of $\theta=0^\circ$ (horizontal), $\theta=30^\circ$, $\theta=45^\circ$ and $\theta=90^\circ$. Module side length ($L=30\text{mm}$) fixed at different locations of ($X/L=5, 10$ and 15) with different input power of ($0.147, 0.51, 0.96, 1.65, 2.34$ and $3.075$) watt, which represent a heat flux of ($32.67, 113.33, 213.33, 366.67, 520$ and $683.33$) $\text{W/m}^2$ respectively. A fan fixed at duct end is operated to move the air within the duct with different air velocities of ($0.2, 0.3, 0.5, 0.7$ and $0.8$) $\text{m/s}$ giving Reynolds number values of ($381.9, 763.7, 954.7, 1336.6$ and $1527.5$) respectively. The system is operating in a transient heat transfer is calculated till steady state is reached. The heat transfer coefficient is estimated in this case. Testing the $\text{Gr}/\text{Re}^2$ values shows that the operating mode is in the mixed convection reaching a forced convection when operating of the highest velocity within the duct. Operating the system in transient and steady state mixed convection mode show that higher air velocities enhances the heat transfer due to giving a chance for the air to transfer the heat during its flow around the cube.
The study shows that a little effect is recognized for the module position and the tilt angle specially at mixed convection operation.

References


Index Terms

Computer Science

Applied Sciences

Keywords

Mixed convection in a duct, cube mixed convection, Duct heat transfer with tilt angle.