





















$u, v$	velocity components, m.s-1
$x, y$	Cartesian coordinates, m
$X, Y$	dimensionless coordinats ( $x/L, y/L$ )
$P$	dimensionless pressure
$Ra$	Rayleigh number, ( $g\beta\Delta TL^3/ \nu\alpha f$ )
$Pr$	Prandtl number ( $(\nu f / \alpha f)$ )
$St$	dimensionless total entropy generation

#### Greek symbols

$\alpha$	thermal diffusivity, m <sup>2</sup> . s-1
$\beta$	thermal expansion coefficient, K-1
$\phi$	solid volume fraction
$\Theta$	dimensionless temperature

$\mu$	dynamic viscosity, kg. m-1.s-1
$\nu$	kinematic viscosity, m <sup>2</sup> .s-1
$\rho$	density, kg. m-3

#### Subscripts

$p$	nanoparticle
$f$	fluid (pure water)
$nf$	nanofluid
$C$	cold
$H$	hot