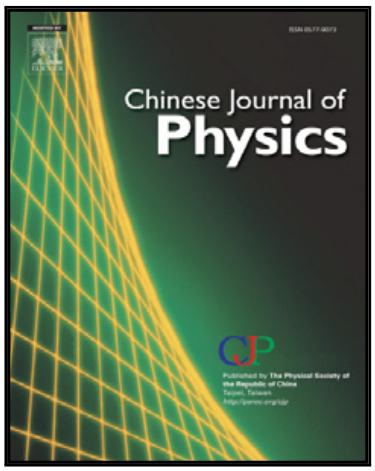

Application of non-Fourier heat flux theory in thermally stratified flow of second grade liquid with variable properties

T. Hayat , M. Zubair , M. Waqas , A. Alsaedi , M. Ayub

PII: S0577-9073(16)30510-X
DOI: 10.1016/j.cjph.2016.11.011
Reference: CJPH 146

To appear in: *Chinese Journal of Physics*

Received date: 5 September 2016
Revised date: 14 October 2016
Accepted date: 2 November 2016

Please cite this article as: T. Hayat , M. Zubair , M. Waqas , A. Alsaedi , M. Ayub , Application of non-Fourier heat flux theory in thermally stratified flow of second grade liquid with variable properties, *Chinese Journal of Physics* (2017), doi: 10.1016/j.cjph.2016.11.011

Application of non-Fourier heat flux theory in thermally stratified flow of second grade liquid with variable properties

T. Hayat [a,b], M. Zubair [a], M. Waqas [a,*], A. Alsaedi [b] and M. Ayub [a]

[a] Department of Mathematics, Quaid-I-Azam University 45320 Islamabad 44000, Pakistan

[b] Nonlinear Analysis and Applied Mathematics (NAAM) Research Group, Department of Mathematics, Faculty of Science, King Abdulaziz University, P. O. Box 80257, Jeddah 21589, Saudi Arabia

*Corresponding author E-mail: mw_@math.qau.edu.pk (M. Waqas)

Abstract: The characteristics of thermal stratification and temperature dependent thermal conductivity in two-dimensional (2D) stretched flow of second grade liquid are analyzed. Thickness of nonlinear stretching surface is variable. New model for heat flux by Cattaneo [2] and Christov [3] is utilized to capture the salient features of thermal relaxation time. Mathematical formulation is modeled employing boundary layer concept. Convergent series solution are obtained for the nonlinear systems. Outcoming results are presented graphically to discuss the characteristics of sundry parameters. Skin friction coefficient is tabulated and examined for various embedded parameters. Our analysis reveals that temperature distribution enhances via larger variable thermal conductivity parameter while it reduces for larger thermal relaxation time and thermal stratified parameters.

Keywords: Non-Fourier heat flux theory; Thermally stratified medium; Variable properties; Second grade liquid.

Nomenclature			
u, v	velocity components	ψ	stream function
μ	dynamic viscosity	α	wall thickness parameter
ν	kinematic viscosity	K	local second grade parameter
ρ	fluid density	k_0	normal stress moduli