

ACKNOWLEDGEMENT

I would like to express all my Gratitude to almighty ALLAH for helping me during the completion of this work.

I wish also, to represent my appreciation to my advisors, Prof. Dr. Moukhtar S. Faltas, Professor of Applied Mathematics and Dr. Allam A. Allam, Assistant Professor of Mathematics for their patient, continuous encouragement, valuable comments and discussions during all stages of research.

Finally, I gratefully present all my thanks to my family and my friends for their continuous supports and encouragements.

TABLE OF CONTENTS

ACKNOWLEDGEMENT	i
TABLE OF CONTENTS	ii
LIST OF FIGURES	v
LIST OF TABLES & IMAGES	vi
SUMMARY	1
INTRODUCTION	3
1 THE BEHAVIOR OF FLUIDS IN SLOW MOTION AND BRINKMAN EQUATION	6
1.1 Dyadic.....	6
1.2 The Equations of Change for a Viscous Fluid	8
1.3 Simplifications of the Navier-Stokes Equations, Slow Motion	12
1.4 Boundary Conditions.....	14
1.5 Axisymmetrical Flow and Stream Function.....	14
1.6 Flow through porous media.....	17
2 THE DARCY-BRINKMAN LONGITUDINAL FLOW IN CORRUGATED TUBES	24
2.1 Introduction	24
2.2 Field Equations.....	27
2.3 Porous Longitudinal Flow in a Corrugated Cylindrical tube	28
2.4 Method of Solution.....	31

2.5	Rate of Flow and Pressure Drop.....	34
2.6	Stokes Flow Limit	36
2.7	Results and Discussions	38
2.8	Conclusion.....	46
3	THE DARCY-BRINKMAN AXIAL FLOW IN CORRUGATED TUBES.....	47
3.1	Introduction	47
3.2	Field Equations.....	48
3.3	Axial Corrugated Roughness Tube	48
3.4	Brinkman Dynamic Equation Satisfied by the Stream Function	51
3.5	Analysis	53
3.6	Pressure Drop	59
3.7	Stokes Flow Limit and Other Asymptotic Results.....	60
3.8	Results and Discussions	63
3.9	Conclusion.....	72
4	THE DARCY-BRINKMAN AXIAL FLOW THROUGH A TUBE WITH STATIONARY SURFACE NOISES	73
4.1	Introduction	73
4.2	Mathematical Formulation	77
4.3	Method of Solution.....	78
4.4	Pressure Drop	84
4.5	Application	86

4.6 Effects of Harmonic Content of $m(z)$	87
4.7 Summary and Conclusion	89
REFERENCES	91
ARABIC SUMMARY	98

LIST OF FIGURES

Figure	page
1.1 Structure of porous medium	19
2.1 Section view of a longitudinal sinusoidal wave rough tube.....	30
2.2 Effect of ϵ , & λ , on Δp^* for a) $\kappa = 0$, b) $\kappa = 2$, and c) $\kappa = 4$	39
2.3 Effect of κ , & λ , on Δp^* for a) $\epsilon = 0.03$, b) $\epsilon = 0.04$, and c) $\epsilon = 0.05$	41
2.4 Effect of corrugations on η (showing the variation vs. λ).....	42
2.5 Effect of corrugations on η (showing the Stokes, Darcian flow).....	43
2.6 Effect of corrugations on Δp^* (showing the variation vs. κ)	44
2.7 Asymptotic results vs. exact of η at a) $\lambda = 2$, b) $\lambda = 5$	45
3.1 Section view of an axial sinusoidal wave rough tube	50
3.2 Effect of corrugations on η (showing the variation vs. λ).....	64
3.3 Effect of corrugations on η (showing the Stokes, Darcian flow).....	65
3.4 Effect of ϵ , & λ , on Δp^* for a) $\kappa = 0$, b) $\kappa = 2$, and c) $\kappa = 4$	67
3.5 Effect of κ , & λ , on Δp^* for a) $\epsilon = 0.03$, b) $\epsilon = 0.04$, and c) $\epsilon = 0.05$	69
3.6 Asymptotic results vs. exact of η at a) $\lambda = 20$, b) $\kappa = 10$	70
3.7 Asymptotic results vs. exact of η_c at small and large values of λ	71
4.1 Observed values of random functions	74

LIST OF TABLES & IMAGES

Table	page
1.1	EXAMPLES OF AVERAGE, BULK POROSITIES 22
1.2	BULK PERMEABILITY OF SOME MATRICES 23

Image	page
1.1	Example of a porous tube 18
2.1	A 3-D view of a longitudinal corrugated tube at different λ, ε 29
3.1	A 3-D view of an axial corrugated tube at different λ, ε 49