

CONTENTS

TITLE PAGE	i
CERTIFICATE	iii
DECLARATION BY THE CANDIDATE	v
COPYRIGHT TRANSFER CERTIFICATE	vii
DEDICATION	ix
ACKNOWLEDGEMENTS	xi
CONTENTS	xiii
LIST OF FIGURES	xix
LIST OF SYMBOLS	xxiii
ABBREVIATIONS	xxv
PREFACE	xxvii
1 INTRODUCTION AND LITERATURE REVIEW	1
1.1 Thermoelasticity: Definition and Applications	1
1.2 Classical Thermoelasticity Theory and Its Drawbacks	2
1.3 Generalized Thermoelasticity Theory	5
1.3.1 Non-Fourier Generalized Thermoelasticity Theory	6
1.3.1.1 Lord-Shulman Thermoelasticity theory (LS): Thermoelasticity with One Thermal Relaxation Parameter	6
1.3.1.2 Green-Naghdi Thermoelasticity Theory (GN)	8
1.3.1.3 Dual-Phase-Lag Thermoelasticity Theory (DPL)	10
1.3.1.4 Three-Phase-Lag Thermoelasticity Theory (TPL)	12

1.3.1.5	Thermoelasticity Theory Based on Exact Heat Conduction Law with a Single Delay	14
1.3.1.6	Non-Local Thermoelasticity Theory	16
1.3.2	Generalized Thermoelasticity Theory Based on Classical Fourier's Law	17
1.3.2.1	Green-Lindsay Thermoelasticity Theory (GL)	17
1.3.2.2	Modified Green-Lindsay Thermoelasticity Theory (MGL)	18
1.3.3	Other Generalized Thermoelasticity Theories	20
1.4	Literature Review	20
1.5	Objective of the Thesis	33
2	THEORETICAL ANALYSIS OF THE THERMOELASTICITY THEORY BASED ON EXACT HEAT CONDUCTION LAW WITH SINGLE DELAY	35
2.1	Some Theorems on Linear Theory of Thermoelasticity based on Exact Heat Conduction Model with Single Delay for Anisotropic Medium ¹	35
2.1.1	Introduction	35
2.1.2	Basic Equations and Problem Formulation	38
2.1.3	Uniqueness of Solution	40
2.1.4	Alternative Formulation of Mixed Problem	43
2.1.5	Variational Theorem	45
2.1.6	Reciprocity Theorem	47
2.1.7	Conclusion	50
2.2	Galerkin-Type Solution for the Theory of Thermoelasticity under an Exact Heat Conduction Law with Single Delay ²	51
2.2.1	Introduction	51
2.2.2	Governing Equations	52
2.2.3	Galerkin-Type Solution of Equations of Motion	54
2.2.4	Galerkin-Type Solution of System of Equations for Steady Oscillations	58
2.2.5	General Solution of System of Equations for Steady Oscillations	61
2.2.6	Conclusion	65
3	ON THE REFLECTION OF THERMOELASTIC WAVES UNDER EXACT HEAT CONDUCTION MODEL WITH SINGLE DELAY	67
3.1	Introduction ³	67
3.2	Problem Formulation and Governing Equations	70

3.3	Solution of the Problem	74
3.3.1	Case A: Incident Longitudinal Wave	76
3.3.2	Case B: Incident Transverse Wave	79
3.4	Numerical Results and Discussion	82
3.4.1	Case A: Results for Incident Longitudinal Wave	89
3.4.2	Case B: Results for Incident Transverse Wave	93
3.4.3	Variations in Phase Velocities	100
3.5	Conclusion	102
4	THEORETICAL ANALYSIS OF MODIFIED GREEN-LINDSAY THERMOELASTICITY THEORY	105
4.1	Introduction ⁴	105
4.2	Governing Equations	107
4.3	Galerkin-Type Solution of Equations of Motion	109
4.4	Galerkin-Type Solution of System of Equations for Steady Oscillations	113
4.5	General Solution of System of Equations for Steady Oscillations	116
4.6	Conclusion	120
5	ANALYSIS OF HARMONIC PLANE WAVE PROPAGATION PREDICTED BY MODIFIED GREEN-LINDSAY THERMOELASTICITY THEORY	121
5.1	Introduction ⁵	121
5.2	Basic Governing Equations	123
5.3	Harmonic Plane Wave	125
5.3.1	Derivation of Dispersion Relation	126
5.4	Expressions for Wave Number and Attenuation Coefficient	128
5.5	Numerical Results and Discussion	130
5.5.1	Analysis on Phase Velocity	131
5.5.2	Analysis on Specific Loss	134
5.5.3	Analysis on Penetration Depth	141
5.6	Conclusion	142
6	SOME INVESTIGATIONS ON THERMOELASTICITY THEORY WITH DUAL PHASE-LAGS	145
6.1	Stochastic Thermoelastic Interactions under Dual-Phase-Lag Model due to Deterministic and Random Temperature Distribution at the Boundary of a Half-Space ⁶	145

6.1.1	Introduction	145
6.1.2	Basic Equations	148
6.1.3	Problem Formulation	149
6.1.4	Solution of the Problem in the Laplace Transform Domain . . .	151
6.1.5	Temperature Distribution in Physical (Space-Time) Domain . .	153
6.1.5.1	Deterministic Temperature	153
6.1.5.2	Stochastic Temperature	156
6.1.6	Stress Distribution	161
6.1.6.1	Deterministic Stress	161
6.1.6.2	Stochastic Stress	161
6.1.7	Displacement Distribution	163
6.1.7.1	Deterministic Displacement	163
6.1.7.2	Stochastic Displacement	164
6.1.8	Numerical Results	166
6.1.9	Conclusion	175
6.2	Domain of Influence Results of Dual-Phase-Lag Thermoelasticity Theory for Natural Stress-Heat-Flux Problem ⁷	177
6.2.1	Introduction	177
6.2.2	Basic Equations and Problem Formulation	179
6.2.3	Preliminaries	181
6.2.4	Energy Identity	182
6.2.5	Domain of Influence Theorem	185
6.2.6	Conclusion	190
6.3	A Study on Generalized Thermoelasticity Theory Based on Non-Local Heat Conduction Model with Dual Phase-Lags ⁸	192
6.3.1	Introduction	192
6.3.2	Basic Governing Equations	193
6.3.3	Problem Formulation	195
6.3.4	Solution of the Problem in the Laplace Transform Domain . . .	196
6.3.5	Numerical Results and Discussion	198
6.3.5.1	Effect of λ_q	198
6.3.5.2	Effect of τ_q	199
6.3.5.3	Effect of τ_θ	204
6.3.6	Conclusion	204

7.1 Summary	207
7.2 Future Scope	214
BIBLIOGRAPHY	217
PUBLICATIONS AND CONFERENCES	239