

## 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	xxii
Preface	xxiv
<b>1 INTRODUCTION AND LITERATURE REVIEW</b>	<b>1</b>
1.1 Thermoelasticity . . . . .	1
1.2 Classical Coupled Theory of Thermoelasticity . . . . .	4
1.3 Limitations of Fourier Law and its Generalization . . . . .	7
1.4 Non-Fourier Heat Conduction Models . . . . .	9
1.5 Generalized Thermoelasticity Theories . . . . .	12

1.5.1	Thermoelasticity with thermal relaxation parameters	13
1.5.2	Thermoelasticity theory of type-I, II and III (GN-I, II and III theory) . . . . .	14
1.5.3	Thermoelasticity with phase-lags . . . . .	15
1.5.4	An exact heat conduction model with a single delay term (Quintanilla (2011)) . . . . .	16
1.5.5	Two-temperature thermoelasticity theory . . . . .	19
1.6	Literature Review . . . . .	21
1.7	Objective of the Thesis . . . . .	31
<b>2</b>	<b>AN INVESTIGATION ON THERMOELASTIC INTER- ACTIONS UNDER TWO-TEMPERATURE THERMOE- LASTICITY WITH TWO RELAXATION PARAMETERS</b>	<b>35</b>
2.1	Introduction . . . . .	35
2.2	Problem Formulation: The basic governing equations . . . . .	37
2.2.1	Boundary Conditions . . . . .	40
2.3	Solution of the Problem . . . . .	41
2.4	Small-time Approximated Solutions . . . . .	45
2.5	Analytical Results . . . . .	48
2.6	Discussions . . . . .	50
<b>3</b>	<b>AN IN-DEPTH INVESTIGATION ON PLANE HARMONIC WAVES UNDER TWO-TEMPERATURE THERMOELAS- TICITY WITH TWO RELAXATION PARAMETERS</b>	<b>53</b>
3.1	Introduction . . . . .	53
3.2	Basic Governing Equations . . . . .	55

---

3.3	Problem Formulation . . . . .	57
3.4	Dispersion Equation . . . . .	58
3.5	Solution of Dispersion Relation under TGL Model . . . . .	60
3.6	Analytical Results . . . . .	62
3.6.1	Case-I: High frequency asymptotic expansions . . . . .	62
3.6.2	Analytical results for $\gamma_{1,2}$ . . . . .	63
3.6.3	Asymptotic results for different wave fields . . . . .	64
3.6.4	Case-II: Low frequency asymptotic expansions . . . . .	66
3.6.5	Amplitude coefficient factor and phase shift of thermodynamic temperature . . . . .	68
3.7	Numerical Results . . . . .	69
3.8	Analysis of Analytical and Numerical Results . . . . .	70
3.8.1	Phase velocity . . . . .	70
3.8.2	Specific loss . . . . .	74
3.8.3	Penetration depth . . . . .	76
3.8.4	Amplitude coefficient factor and phase shift of thermodynamic temperature . . . . .	78
3.9	Conclusions . . . . .	79
<b>4</b>	<b>INFINITE SPEED BEHAVIOR OF TWO-TEMPERATURE GREEN LINDSAY THERMOELASTICITY THEORY UNDER TEMPERATURE DEPENDENT THERMAL CONDUCTIVITY</b>	<b>83</b>
4.1	Introduction . . . . .	83
4.2	Problem Formulation . . . . .	85

4.3	Solution of the Problem . . . . .	89
4.3.1	Boundary Conditions . . . . .	92
4.4	Numerical Results and Discussion . . . . .	94
4.4.1	Displacement, $u$ . . . . .	95
4.4.2	Conductive temperature, $\phi$ . . . . .	96
4.4.3	Thermodynamic temperature, $\theta$ . . . . .	97
4.4.4	Stresses, $\sigma_{rr}$ and $\sigma_{\varphi\varphi}$ . . . . .	99
<b>5</b>	<b>AN INVESTIGATION ON THERMOELASTIC INTER-ACTIONS UNDER AN EXACT HEAT CONDUCTION MODEL WITH A DELAY TERM</b>	<b>101</b>
5.1	Introduction . . . . .	101
5.2	Basic Governing Equations . . . . .	103
5.3	Problem Formulation . . . . .	105
5.4	Solution of the Problem . . . . .	106
5.4.1	Boundary Conditions . . . . .	111
5.5	Short-time Approximated Solutions . . . . .	112
5.6	Analysis of Analytical Results . . . . .	114
5.7	Numerical Results and Discussion . . . . .	115
<b>6</b>	<b>INVESTIGATION ON THE EFFECTS OF TEMPERATURE DEPENDENCY OF MATERIAL PARAMETERS ON A THERMOELASTIC LOADING PROBLEM</b>	<b>123</b>
6.1	Introduction . . . . .	123
6.2	Problem Formulation . . . . .	124
6.3	Solution of the Problem . . . . .	128

---

6.4	Applications of the Problem . . . . .	131
6.4.1	Case I: Unit Step Increase in Temperature and Zero Stress of the Boundary of the Spherical Shell . . . . .	131
6.4.2	Case II: Exponential Variation in Temperature and Zero Stress of the Boundary of the Shell . . . . .	132
6.4.3	Case III: Sinusoidal Varying Temperature and Zero Displacement at the Boundary of the Spherical Shell	132
6.5	Numerical Results and Discussion . . . . .	134
<b>7</b>	<b>INVESTIGATION ON THERMOELASTIC BEHAVIOR OF A FUNCTIONALLY GRADED SPHERICAL SHELL UNDER HEAT CONDUCTION MODEL WITH A DE-LAY</b>	<b>143</b>
7.1	Introduction . . . . .	143
7.2	Formulation of the Problem . . . . .	147
7.2.1	Basic Governing Equations . . . . .	148
7.2.2	Boundary Conditions . . . . .	152
7.3	Solution using Galerkin Finite Element Method . . . . .	152
7.4	Numerical Results and Discussion . . . . .	158
7.5	Conclusions . . . . .	166
<b>8</b>	<b>SUMMARY OF THE THESIS AND SCOPE FOR FURTHER WORK</b>	<b>169</b>
8.1	Summary of the Work . . . . .	169
8.2	Future Scopes . . . . .	178

<b>Appendix</b>	<b>181</b>
(A-1): Stehfest Method of Laplace Inversion . . . . .	181
(A-2): Zakian Method of Laplace Inversion . . . . .	181
<b>Bibliography</b>	<b>183</b>
<b>Publications and Workshops</b>	<b>202</b>