

# Contents

<b>List of Figures</b>	xvii
<b>List of Tables</b>	xix
<b>Abstract</b>	xxi
<b>1 Introduction</b>	1
1.1 Moving Boundary Problems . . . . .	1
1.2 Historical Background . . . . .	2
1.3 Fractional calculus . . . . .	7
1.3.1 Definition of Caputo fractional derivative and its properties . . . . .	8
1.4 Some Methods for treatment of moving boundary problems . . . . .	9
1.4.1 Finite Difference Method (FDM) . . . . .	9
1.4.2 Heat Balance Integral Method . . . . .	10
1.4.2.1 Quadratic temperature profile . . . . .	11
1.4.2.2 Cubic temperature profile . . . . .	11
1.4.2.3 Exponential temperature profile . . . . .	12
1.4.3 Genocchi Operational Matrix Method . . . . .	12
1.5 Research Gap, Objective and Novelty of the Thesis . . . . .	12
<b>2 A Stefan problem with moving phase change material, variable thermal conductivity and periodic boundary condition</b>	15
2.1 Introduction . . . . .	15
2.2 Mathematical Model . . . . .	17
2.2.1 Dimensionless form . . . . .	18
2.3 Numerical solution . . . . .	19
2.4 Consistency . . . . .	22
2.5 Stability . . . . .	25
2.6 Convergence . . . . .	27
2.7 Results and Discussions . . . . .	29
2.8 Conclusion . . . . .	38

---

<b>3 A moving boundary problem with space-fractional diffusion logistic population model and density-dependent dispersal rate</b>	<b>39</b>
3.1 Introduction . . . . .	39
3.2 Mathematical Model . . . . .	41
3.3 Numerical solution of the problem . . . . .	42
3.4 Consistency . . . . .	46
3.5 Stability . . . . .	50
3.5.1 Positiveness . . . . .	50
3.5.2 Stability . . . . .	53
3.6 Convergence . . . . .	54
3.7 Results and Discussions . . . . .	56
3.8 Conclusion . . . . .	65
<b>4 Heat balance integral method for a time - fractional Stefan problem with Robin boundary condition and temperature - dependent thermal conductivity</b>	<b>67</b>
4.1 Introduction . . . . .	67
4.2 Mathematical Model . . . . .	70
4.2.1 Dimensionless form . . . . .	71
4.3 Heat Balance Integral Method . . . . .	71
4.3.1 Quadratic Temperature Profile . . . . .	72
4.3.2 Exponential temperature profile . . . . .	74
4.4 Results and Discussion . . . . .	75
4.4.1 Case 1: Fractional derivative . . . . .	75
4.4.2 Case 2: Integer order derivative . . . . .	76
4.5 Conclusion . . . . .	83
<b>5 A numerical solution of a non-classical Stefan problem with space-dependent thermal conductivity, variable latent heat and Robin boundary condition</b>	<b>85</b>
5.1 Introduction . . . . .	85
5.2 Preliminaries . . . . .	88
5.3 Mathematical formulation and its solution . . . . .	91
5.3.1 Mathematical model . . . . .	91
5.3.2 Similarity transform . . . . .	92
5.3.3 Operational matrix method with collocation scheme . . . . .	92
5.4 Results and discussions . . . . .	94
5.5 Conclusions . . . . .	103
<b>6 Overall conclusion &amp; scope for the future work</b>	<b>105</b>
6.1 Conclusion . . . . .	105
6.2 Scope for future study . . . . .	107

<b>Bibliography</b>	<b>109</b>
<b>Research Publications</b>	<b>135</b>