## TABLE OF CONTENTS

Subjects	Page no
Acknowledgements	i
Dedication	iii
Declaration	iv
Certificate	V
Abstract	vi
Table of Contents	viii
List of Tables	xi
List of Figures	xii
Nomenclature	XV
CHAPTER 1: GENERAL INTRODUCTION	1-12
1.1 Back Ground	112
1.1.1 Shale Gas.	1
1.1.2 Shale Gas Reservoirs in United States.	2
1.1.3 Shale Gas Distribution in the World.	5
1.1.4 Shale Gas Scenario in India.	6
1.2 Hydraulic Fracturing.	8
1.3 Statement of the Problem.	9
	11
<ul><li>1.4 Research Gap.</li><li>1.5 Research Objectives.</li></ul>	11
1.6 Thesis Outline	11
1.0 Thesis Outline	
CHAPTER 2: LITERATURE REVIEW	13-30
2.1 Flow in Fractured Shale.	13
2.2 Knudsen Diffusion and Desorption in Shale Matrix.	13
2.3 Modeling Production from Fractured Horizontal Wells.	18
2.4 Pressure Dependent Natural Fracture Permeability.	24
2.5 Reservoir Simulation Models for Gas Shales.	21
2.5.1 Single Porosity Model.	24
2.5.2 Dual Porosity Model.	24
2.5.3 Multiple Interaction Continua Medium.	26
2.5.4 Dual Permeability Model.	26
2.5.5 Multiple Porosity Model.	20
2.6 Gas Desorption	28
2.7 Flow Mechanisms in Shale Gas Reservoirs.	20
2.7 How Mechanishis in Shale Gus Reservoirs.	27
	21.45
CHAPTER 3:MODEL SELECTION IN SHALE GAS RESERVOIR	31-45
3.1 Reservoir Model.	31
3.2 Mass Balance Equation for Gas Flow in the Matrix.	20
3.2.1 Assumptions.	32
3.2.2 Mass Balance Equation.	32
3.2.3 Discretization Method.	39

3.3 Algorithm	43
CHAPTER 4: MODELING OF FLUID FLOW IN HYDRAULIC FRACTURES	46-62
4.1 Material Balance Equation for Flow of Gas in Hydraulic Fracture.	46
4.1.1 Assumptions.	46
4.1.2 Discretization Method.	49
4.2 Material Balance Equation for flow of water in the Hydraulic Fracture.	52
4.2.1 Assumptions	52
4.2.2 Discretization Method.	55
4.3 Algorithm.	59
CHAPTER 5: FLOW OF GAS FROM HYDRAULIC FRACTURE TO HORIZONTAL WELLBORE	63-68
5.1 Pressure Variation in Matrix Blocks	63
5.2 Pressure Variation in Induced or Hydraulic Fractures.	65
5.3 Flow Rate Variation under different Cases.	67
5.3.1 Case 1: Shale Reservoir with Horizontal Wellbore and No Hydraulic Fracture.	67
5.3.2 Case 2: Shale Reservoir with Horizontal Wellbore and one Hydraulic	67
Fracture.	
5.3.3 Case 3: Shale Reservoir with Horizontal Wellbore and Two Hydraulic	67
Fractures.	
5.3.4 Case 4: Shale Reservoir with Horizontal Wellbore and Three Hydraulic	67
Fractures.	01
5.3.5 Case 5: Shale Reservoir with Horizontal Wellbore and Four Hydraulic	67
Fractures.	07
5.3.6 Case 6: Shale Reservoir with Horizontal Wellbore and Five Hydraulic	67
Fractures.	
	<ol> <li>50. 50</li> </ol>
CHAPTER 6: RESERVOIR SIMULATION: BASE MODEL CONSTRUCTION AND SIMULATION RESULTS	69-72
6.1 Base Model Construction.	69
6.2 Simulation Results.	71
6.3 2D View Pressure Variation in Shale Reservoir during Gas Production.	72
CHAPTER 7: INFLUENCING FACTORS SENSITIVITY ANALYSIS	73-87
7.1 Sensitivity Analysis of Different Reservoir and Hydraulic Fracture Parameters.	74
7.1.1 Effect of Matrix Porosity.	74
7.1.2 Effect of Gas Desorption	76
7.1.2.1 Effect of Langmuir Pressure.	76
7.1.2.2 Effect of Langmuir Volume.	78
7.1.3 Effect of Number of Hydraulic Fractures.	81
7.1.4 Effect of Hydraulic Fracture Permeability.	83
7.1.5 Effect of Hydraulic Fracture Width.	85

CHAPTER 8:RESULTS AND DISCUSSIONS	88-94
8.1 Case 1: Only Wellbore with No Hydraulic Fractures.	88
8.2 Case 2: Wellbore with Singly Hydraulic Fracture.	89
8.3 Case 3: Wellbore with Two Hydraulic Fractures.	90
8.4 Case 4: Wellbore with Three Hydraulic Fractures.	91
8.5 Case 5: Wellbore with Four Hydraulic Fractures.	92
8.6 Case 6: Wellbore with Five Hydraulic Fractures.	93
CHAPTER 9:CONCLUSIONS AND RECOMMENDATIONS	95-97
9.1 Conclusion.	95
9.2 Recommendations.	96
9.3 Futuristic Scope.	96
BIBLIOGRAPHY	98-103
ANNEXURE-I	104-119
ANNEXURE-II	120-136
RESUME	137-138
LIST OF PUBLICATIONS	139