

<b>List of Figures</b>		<b>Page No.</b>
<b>Fig. 1.1</b>	Distribution of earth's water	02
<b>Fig. 1.2</b>	Sources of groundwater water contamination	03
<b>Fig. 1.3</b>	The Water Cycle	06
<b>Fig. 1.4</b>	Different types of aquifers	19
<b>Fig. 1.5</b>	The distribution of sub-surface water	20
<b>Fig. 1.6</b>	Diagram showing several types of Rock Interstices	20
<b>Fig. 1.7</b>	Examples of natural porous materials	22
<b>Fig. 1.8</b>	Darcy's experiments	26
<b>Fig. 1.9</b>	Example of the diffusion process	36
<b>Fig. 1.10</b>	Elementary control volume	37
<b>Fig. 2.1.1</b>	Physical problem	66
<b>Fig. 2.1.2</b>	Plots of analytical and numerical results of concentration factor vs. column length for the conservative system at $t = 2.5$ hrs	67
<b>Fig. 2.1.3</b>	Plots of analytical and numerical results of concentration factor vs. column length for the conservative system at $t = 5$ hrs	67
<b>Fig. 2.1.4</b>	Plots of concentration profiles vs. column length for a conservative finite-length system with first-type source boundary conditions at 2.5,5,10,15 and 20 hours	68
<b>Fig. 2.1.5</b>	Plots of concentration profiles vs. column length for a non-conservative finite-length system with first-type source boundary conditions at 2.5,5,10,15 and 20 hours	69
<b>Fig. 2.2.1</b>	Concentration profiles $C(x,t)$ vs. $x$ at $t = 2.5,5,10,15,$ and 20 hrs for (a) $\beta = 1,$ (b) $\beta = 0.9,$ (c) $\beta = 0.8,$ (d) $\beta = 0.7,$ for a conservative solute	81
<b>Fig. 2.2.2</b>	Concentration profiles $C(x,t)$ vs. $x$ at $t = 2.5,5,10,15,$ and 20 hrs for (a) $\beta = 1,$ (b) $\beta = 0.9,$ (c) $\beta = 0.8,$ (d) $\beta = 0.7,$ for a non-conservative solute	82
<b>Fig. 2.2.3</b>	Concentration profiles $C(x,t)$ vs. $x$ for various $\beta$ at (a) $t = 2.5,$ (b) $t = 5,$ (c) $t = 10,$ and (d) $t = 20$ hrs for a conservative solute	83

<b>Fig. 2.2.4</b>	Concentration profiles $C(x,t)$ vs. $x$ for various $\beta$ at (a) $t = 2.5$ , (b) $t = 5$ , (c) $t = 10$ , and (d) $t = 20$ hrs for a non- conservative solute	85
<b>Fig. 3.1</b>	Chebyshev Gauss-Lobatto grid for $N_x = 3 = N_y$ together with $c_{pq}$ 's	101
<b>Fig. 3.2</b>	Normalized concentration distributions for conservative system at different time levels (a) $t = 0.25$ day, (b) $t = 0.5$ day, (a) $t = 0.75$ day, (a) $t = 1$ day	106
<b>Fig. 3.3</b>	Normalized concentration distributions for non-conservative system at different time levels (a) $t = 0.25$ day, (b) $t = 0.5$ day, (a) $t = 0.75$ day, (a) $t = 1$ day	107
<b>Fig. 3.4</b>	Comparison of normalized concentration distributions for the conservative system at different time levels	107
<b>Fig. 3.5</b>	Comparison of normalized concentration distributions for the non-conservative system at different time levels	107
<b>Fig. 3.6</b>	Comparison between conservative and non-conservative system at $t = 5$ day	108
<b>Fig. 3.7</b>	Normalized concentration distributions for conservative system for $y = 10$ cm at different time levels (a) $t = 0.25$ day, (b) $t = 0.5$ day, (a) $t = 0.75$ day, (a) $t = 1$ day	108
<b>Fig. 3.8</b>	Normalized concentration distributions for non-conservative system for $y = 10$ cm at different time levels (a) $t = 0.25$ day, (b) $t = 0.5$ day, (a) $t = 0.75$ day, (a) $t = 1$ day	109
<b>Fig. 3.9</b>	Normalized concentration distributions for a conservative system for $y = 10$ cm at different time levels	109
<b>Fig. 3.10</b>	Normalized concentration distributions for a Non-conservative system for $y = 10$ cm at different time levels	110
<b>Fig. 4.1</b>	Plot of the approximate solution of Example 1 vs. $x$ and $t$ for $M = N = 3$	120
<b>Fig. 4.2</b>	Comparison between exact and approximate solutions of Example 1 vs. $x$ and $t$ for $M = N = 3$	121
<b>Fig. 4.3</b>	Absolute errors of Example 1 vs. $x$ and $t$ for $M = N = 3$	121

<b>Fig. 4.4</b>	Plot of the approximate solution of Example 2 vs. $x$ and $t$ for $M = N = 3$	123
<b>Fig. 4.5</b>	Comparison between the exact and approximate solution of Example 2 vs. $x$ and $t$ for $M = N = 3$	123
<b>Fig. 4.6</b>	Absolute errors of Example 2 vs. $x$ and $t$ for $M = N = 3$	123
<b>Fig. 4.7</b>	Plot of the approximate solution of Example 3 vs. $x$ and $t$ for $M = N = 3$	125
<b>Fig. 4.8</b>	Comparison between the exact and approximate solution of Example 3 vs. $x$ and $t$ for $M = N = 3$	125
<b>Fig. 4.9</b>	Absolute errors of Example 3 vs. $x$ and $t$ for $M = N = 3$	125
<b>Fig. 4.10</b>	Plot of the approximate solution of Example 4 vs. $x$ and $t$ for $M = N = 3$	127
<b>Fig. 4.11</b>	Comparison between the exact and approximate solution of Example 4 vs. $x$ and $t$ for $M = N = 3$	127
<b>Fig. 4.12</b>	Absolute errors of Example 4 vs. $x$ and $t$ for $M = N = 3$	127
<b>Fig. 4.13</b>	Plot of the approximate solution of Example 5 vs. $x$ and $t$ for $M = N = 3$	129
<b>Fig. 4.14</b>	Comparison between the exact and approximate solution of Example 5 vs. $x$ and $t$ for $M = N = 3$	129
<b>Fig. 4.15</b>	Absolute errors of Example 5 vs. $x$ and $t$ for $M = N = 3$	129
<b>Fig. 5.1</b>	Comparison between exact and approximate solutions of Example 1 vs. $x$ for $M = N = 3$ at $t = 1$ hr	143
<b>Fig. 5.2</b>	Variation of absolute error of Example 1 vs. $x$ for $M = N = 3$ at $t = 1$ hr	144
<b>Fig. 5.3</b>	Plot of the approximate solution of Example 2 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	145
<b>Fig. 5.4</b>	Comparison between the exact and approximate solution of Example 2 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	145
<b>Fig. 5.5</b>	Variation of absolute error of Example 2 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	146
<b>Fig. 5.6</b>	Plots of the approximate solution of Example 2 vs. $x$ for different value of $\gamma, \eta$ and $M = N = 3$ at $t = 1$ hr	146

<b>Fig. 5.7</b>	Comparison between exact and approximate solutions of Example 3 vs. $x$ for $M = N = 3$ at $t = 1$ hr	148
<b>Fig. 5.8</b>	Variation of absolute error of Example 3 vs. $x$ for $M = N = 3$ at $t = 1$ hr	148
<b>Fig. 5.9</b>	Plot of the approximate solution of Example 4 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\lambda = 1$	150
<b>Fig. 5.10</b>	Comparison between exact and approximate solutions of Example 4 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\lambda = 1$	150
<b>Fig. 5.11</b>	Variation of absolute error of Example 4 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\lambda = 1$	150
<b>Fig. 5.12</b>	Plots of the approximate solution of Example 4 vs. $x$ for different value of $\gamma$ and $M = N = 3$ at $t = 1$ hr	151
<b>Fig. 5.13</b>	Plot of the approximate solution of Example 5 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	152
<b>Fig. 5.14</b>	Comparison between exact and approximate solutions of Example 5 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	153
<b>Fig. 5.15</b>	Variation of absolute error of Example 5 vs. $x$ and $t$ for $M = N = 3, \gamma = 2$ and $\eta = 1$	153
<b>Fig. 5.16</b>	Plots of the approximate solution of Example 5 vs. $x$ for different value of $\gamma, \eta$ and $M = N = 3$ at $t = 1$ hr	153
<b>Fig. 6.1</b>	Plots of the approximate solution vs. $x$ when $\lambda = -1, 0, 1$ at $t = 1$ hr for $M = N = 3$	160
<b>Fig. 6.2</b>	Plots of the approximate solution vs. $x$ when $\lambda = -1, 0, 1$ at $t = 1$ hr for $M = N = 3$	161
<b>Fig. 6.3</b>	Plots of the approximate solution vs. $x$ when $\lambda = -1, 0, 1$ at $t = 1$ hr for $M = N = 3$	161
<b>Fig. 7.1</b>	The absolute errors of Example 1 vs. $x$ and $y$ with $N = M_1 = M_2 = 3$ at (a) $t = 0.2$ , (b) $t = 0.4$ , (c) $t = 0.6$ , (d) $t = 0.8$ , (e) $t = 1$	174
<b>Fig. 7.2</b>	The absolute errors of Example 2 vs. $x$ and $y$ with $N = M_1 = M_2 = 3$ at (a) $t = 0.2$ , (b) $t = 0.4$ , (c) $t = 0.6$ , (d) $t = 0.8$ , (e) $t = 1$	176

- Fig. 7.3** The absolute errors of Example 3 vs.  $x$  and  $y$  with  $N = M_1 = M_2 = 3$  at (a)  $t=0.2$ , (b)  $t=0.4$ , (c)  $t=0.6$ , (d)  $t=0.8$ , (e)  $t=1$  178
- Fig. 7.4** The absolute errors of Example 4 vs.  $x$  and  $y$  with  $N = M_1 = M_2 = 3$  at (a)  $t=0.2$ , (b)  $t=0.4$ , (c)  $t=0.6$ , (d)  $t=0.8$ , (e)  $t=1$  180
- Fig. 7.5** The absolute errors of Example 5 vs.  $x$  and  $y$  with  $N = M_1 = M_2 = 3$  at (a)  $t=0.2$ , (b)  $t=0.4$ , (c)  $t=0.6$ , (d)  $t=0.8$ , (e)  $t=1$  183