LIST OF FIGURES

Figure 1.1 Global greenhouse gas component contribution and its sectors	1
Figure 3.1 Schematic diagram of absorption set-up: 1. CO_2 cylinder; 2. N_2	35
cylinder; 3.pressure regulator; 4. stainless steel valve 5. gas-flow	
rotameter; 6. gas simulation chamber; 7. glass tee 8. constant	
temperature water bath; 9. water saturator; 10. bubble column	
fitted with septum; 11. thermometer; 12. silica bed column; 13.	
portable multi-flue gas analyzer; 14. exhaust	
Figure 3.2 Schematic diagram of desorption set-up: 1. N ₂ cylinder, 2. pressure	37
regulator, 3. gas flow meter, 4. stainless steel valve, 5. glass tee, 6.	
heating and magnetic stirrer, 7. four necked round bottom flask	
placed in silicon oil bath and fitted with septum and thermometer,	
8. condenser, 9. silica bed column, 10. portable multi-flue gas	
analyzer, 11. exhaust, 12. gas storage tank	
Figure 3.3 Chemical structures of alkanolamines and diamines	40
Figure 3.4 CO ₂ loading in 2.5 M MEA solution at temperature 313.15 K	41
Figure 3.5 CO ₂ loading in various amine solutions of total concentration of 2.5	42
М	
Figure 3.6 Absorption profile of CO ₂ in various amine solutions at	44
temperature 313.15 K and total concentration of 2.5 M	
Figure 3.7 Absorption rate of CO ₂ in various amine solutions of total	46
concentration of 2.5 M	
Figure 3.8 Plot of absorption rate versus absorption capacity in various amine	47

solutions at temperature 363.15 K and the total concentration of 2.5 M

Figure 3.9 Desorption profile of CO ₂ from various carbonated amine solutions	48
at temperature 363.15 K and total concentration of 2.5 M	
Figure 3.10 Desorption rate CO ₂ in various amine solutions of total	49
concentration of 2.5 M	
Figure 3.11 Plot of desorption rate versus desorption capacity from various	50
amine solutions at temperature 363.15 K and the total	
concentration of 2.5 M	
Figure 3.12 Cyclic capacity of CO ₂ in various amine solutions	51
Figure 3.13 Regeneration efficiency of amine blends in different cycle	52
Figure 4.1 Schematic diagram of the experimental set-up: (1) CO ₂ gas	61
cylinder, (2) N_2 gas cylinder, (3) gas-flow rotameter, (4) gas mixing	
chamber, (5) stainless steel ,(6) water bath, (7) bubbling absorber,	
(8) thermometer, (9) moisture absorber column, (10) flue gas	
analyzer and (11) exhaust	
Figure 4.2 Variation of the CO ₂ solubility α_{CO_2} with absorption time for	64
different mole fraction of AEEA in total amine (X) of \blacktriangle , 0.20; \blacksquare ,	
0.10 and \blacklozenge , 0.02, at C _T 2 kmol/m ³ and p _{CO2} 20.265 kPa	
Figure 4.3 CO ₂ solubility α_{co_2} with different AEEA mole fraction in total	65
amine X for total amine concentration C_T of \blacklozenge , 1 kmol/m ³ ; \blacksquare , 2	
$kmol/m^3$; \blacktriangle , 3 $kmol/m^3$, at T 313.15 K and pCO ₂ 20.265 kPa	
Figure 4.4 CO ₂ solubility α_{co} with different total amine concentration C _T at	66
T 313 15 K and pCO ₂ 20 265 kPa for $\mathbf{V} = 0.2$	
1 313.13 K aliu pCO ₂ 20.203 KFa, 101 A 0.2	

Figure 4.5 Variation of the CO ₂ solubility α_{CO_2} with absorption time at various	67
inlet partial pressure of CO_2 in a 2 kmol/m ³ amine blend with	
AEEA mole fraction in total amine of 0.2	
Figure 4.6 CO ₂ solubility α_{CO_2} with partial pressure of CO ₂ at T 313.15 K in 2	68
kmol/m ³ amine blend with AEEA mole fraction in total amine of	
0.2	
Figure 4.7 Variation of the CO ₂ solubility α_{CO_2} with absorption time at various	69
temperatures T (K) in a 2 kmol/m ³ amine blend having AEEA mole	
fraction in total amine of 0.2	
Figure 4.8 CO ₂ solubility α_{CO_2} with temperature in 2 kmol/m ³ amine blend	70
having AEEA mole fraction of 0.2 at 20.265 kPa	
Figure 4.9 Plot between calculated (α_{cal}) and experimental CO ₂ solubility (α_{exp})	74
for DEEA+AEEA blend	
Figure 5.1 Schematic diagram for CO_2 solubility measurement: (1) CO_2 gas	82
cylinder, (2) N_2 gas cylinder, (3) gas flow meter, (4) gas mixing	
chamber, (5) stainless steel valves, (6) water bath, (7) bubble	
column, (8) thermometer, (9) moisture absorber column, (10)	
multi-flue gas analyzer and (11) exhaust	
Figure 5.2 CO_2 absorbed against time t with different mole fraction of HMDA	85
in total amine mixture X at temperature T 313.15 K, partial pressure	
of CO ₂ 20.265 kPa and total amine concentration $C_T 2 \text{ kmol/m}^3$	
Figure 5.3 CO ₂ solubility α CO ₂ against mole fraction of HMDA in total amine	86
mixture X with different total amine concentrations C_T at	
temperature T 313.15 K and partial pressure of CO ₂ 20.265 kPa	

Figure 5.4 CO ₂ solubility α CO ₂ against total amine concentrations C _T at	87
temperature T 313.15 K, mole fraction of HMDA in total amine	
mixture X 0.20 and partial pressure of CO ₂ 20.265 kPa	
Figure 5.5 CO_2 absorbed against time t with different partial pressure of CO_2	88
at temperature T 313.15 K, mole fraction of HMDA in total amine	
and total amine concentration $C_T 2 \text{ kmol/m}^3$	
Figure 5.6 CO ₂ solubility α_{CO2} against partial pressure of CO ₂ at total amine	89
concentration $C_T 2 \text{ kmol/m}^3$, temperature T 313.15 K and mole	
fraction of HMDA in total amine mixture X 0.2	
Figure 5.7 CO ₂ absorbed against time t with different temperature T at partial	90
pressure of CO ₂ 20.265 kPa, total amine concentration $C_T 2$	
kmol/m ³ and mole fraction of HMDA in total amine mixture X	
0.20	
Figure 5.8 CO ₂ solubility α_{CO2} against temperature T at total amine	91
concentration $C_T 2$ kmol/m ³ , partial pressure of CO ₂ 20.265 kPa	
and mole fraction of HMDA in total amine mixture X 0.20	
Figures 5.9 Parity plot between predicted (α_{cal}) and experimental CO ₂	96
solubility (α_{CO_2}) for DEEA+HMDA blend	
Figures 5.10 Plot between $ln(p_{CO_2})$ versus 1/T at different equilibrium	98
solubility of CO ₂ in DEEA+HMDA solution	
Figure 6.1 Equilibrium solubility of CO_2 in 4.93 mol/kg MEA solution at	110
313.15 K	
Figure 6.2 Plot of equilibrium solubility of CO ₂ versus EDA mole fraction in	111
total amine solution at 313.15 K and 20.27 kPa	

Figure 6.3 Plot of equilibrium solubility of CO ₂ versus concentration of total	112
amine solution with 0.20 mole fraction of EDA at 313.15 K and	
20.27 kPa	
Figure 6.4 Plot of equilibrium solubility of CO_2 versus partial pressure of CO_2	113
with 2.63 mol/kg concentration of total amine solution and 0.20	
mole fraction of EDA at 313.15 K	
Figure 6.5 Plot of equilibrium solubility of CO ₂ versus temperature with 2.63	114
mol/kg concentration of total amine solution and 0.20 mole fraction	
of EDA at 20.27 kPa	
Figure 6.6 Parity plot between calculated (α_{cal}) and experimental CO ₂	120
solubility (α_{exp}) for DEEA+EDA blend	

- **Figure 6.7** Plot between $\ln(p_{CO_2})$ versus 1/T at different equilibrium solubility 122 of CO₂ in DEEA+EDA solution
- **Figure A.1** Plot between $\ln(p_{CO_2})$ versus 1/T at different equilibrium solubility 148

of CO_2 in DEEA+AEEA solution