**Study Unit 9**

**Activity 9-5**

1.      Suppose that p represents the statement "It is sunny" and q the statement "It is humid". Write each of the following in abbreviated form:

(a)      It is sunny and it is not humid: p $\land \neg$ q

(b)      It is humid or it is sunny: q $\lor$ p
(c)      It is false that it is humid: $\neg$ q

(d)      It is false that it is sunny and humid: $\neg$ (p $\land$ q)

(e)      It is neither sunny nor humid: $\neg$ p $\land \neg$ q

(f)      It is not the case that if it is sunny then it is humid: $\neg$ (p $\rightarrow$ q)

(g)      It is humid if it is sunny: p $\rightarrow$ q

(h)      It is humid only if it is sunny: q $\rightarrow$ p

(i)      It is sunny if and only if it is humid: p $\leftrightarrow$ q

(j)      If it is false that it is either sunny or humid, then it is not sunny: $\neg$ [(p $\lor$ q) $\land \neg$ (p $\land$ q)] $\rightarrow \neg$ p

2.      Construct the truth tables for the following compound statements:

(a)      [($\neg$q) $\rightarrow$ ($\neg$p)] $\rightarrow$ (p $\rightarrow$ q)]

| p | q | ¬p | ¬q | (¬q) → (¬p) | p → q | [(¬q) → (¬p)] → (p → q) |
|---|---|----|----|-------------|-------|-------------------------|
| T | T | F | F | T | T | T |
| T | F | F | T | F | F | T |
| F | T | T | F | T | T | T |
| F | F | T | T | T | T | T |

(b)    [¬p → (q ∧ (¬q))] → p

| p | q | ¬ p | ¬q | q ∧ (¬q) | ¬p→(q ∧ (¬q)) | [¬p → (q ∧ (¬q))] → p |
|---|---|-----|----|----------|----------------|------------------------|
| T | T | F | F | F | T | T |
| T | F | F | T | F | T | T |
| F | T | T | F | F | F | T |
| F | F | T | T | F | F | T |

(c)    p ∨ (¬p)

| p | ¬p | p ∨ (¬p) |
|---|----|----------|
| T | F | T |
| F | T | T |

(d)    [p ∧ (p → q)] → q

| p | q | p → q | p ∧ (p → q) | [p ∧ (p → q)] → q |
|---|---|-------|-------------|--------------------|
| T | T | T | T | T |
| T | F | F | F | T |
| F | T | T | F | T |
| F | F | T | F | T |

(e)    (p ∨ q) ∧ (¬p ∨ ¬q)

| p | q | p ∨ q | ¬p | ¬q | (¬p ∨ ¬q) | (p ∨ q) ∧ (¬p ∨ ¬q) |
|---|---|-------|----|----|-----------|----------------------|
| T | T | T | F | F | F | F |
| T | F | T | F | T | T | T |
| F | T | T | T | F | T | T |
| F | F | F | T | T | T | F |

(f)     (¬p → [ q ∧ r ] ) ∨ r

| p | q | r | ¬ p | q ∧ r | ¬p → [ q ∧ r ] | (¬p → [ q ∧ r ] ) ∨ r |
|---|---|---|-----|-------|----------------|------------------------|
| T | T | T | F | T | T | T |
| T | T | F | F | F | T | T |
| T | F | T | F | F | T | T |
| T | F | F | F | F | T | T |
| F | T | T | T | T | T | T |
| F | T | F | T | F | F | F |
| F | F | T | T | F | F | T |
| F | F | F | T | F | F | F |

(g)     (p → [ q ∧ r ] ) ↔ ( [ p → q ] ∨ [ p → r ] )

| p | q | r | q ∧ r | p → [ q ∧ r ] | p → q | p → r | [ p→q ] ∨ [ p→r ] | (p→[ q ∧ r ])↔ ([ p→q ] ∨ [ p→r ]) |
|---|---|---|-------|----------------|-------|-------|-------------------|-------------------------------------|
| T | T | T | T | T | T | T | T | T |
| T | T | F | F | F | T | F | T | F |
| T | F | T | F | F | F | T | T | F |
| T | F | F | F | F | F | F | F | T |
| F | T | T | T | T | T | T | T | T |
| F | T | F | F | T | T | T | T | T |
| F | F | T | F | T | T | T | T | T |
| F | F | F | F | T | T | T | T | T |