**Lab 02 Applications of propositional logic**

**Objective**

Solving exercises from the textbook in chapter 1.2-1.3

**Current Lab Learning Outcomes (LLO)**

By completion of the lab, the students should be able to:

understand the truth values of the compound propositions, negating the compound proposition

**Lab Requirements**

Students allowed using their lecture notes in the lab in order to solve the exercises.

**Lab Assessment**

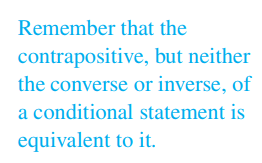
1- Divide students to groups and let them to solve the given example.

2- Discuss the answers with the groups and write on board the optimal solution.

**LabDescription**

1. Translate the given statement into propositional logic using the propositions provided

You cannot edit a protected Wikipedia entry unless you are an administrator. Express your answer in terms of *e*:“You can edit a protected Wikipedia entry” and *a*: “You are an administrator



￢e unless a p unless q = ￢q → p

￢a → ￢e contrapositive *e* → *a*

*/\* e* → *a or* ￢a → ￢*e (p* → q is q unless ￢p )

1. Express these system specifications using the propositions *p* “The message is scanned for viruses” and *q* “The message was sent from an unknown system” together with logical connectives (including negations).

**a)** “The message is scanned for viruses whenever the message was sent from an unknown system.”

**a)** *q* →*p*

**b)** “The message was sent from an unknown system but it was not scanned for viruses.”

**b)** *q* ^￢*p*

**c)** “It is necessary to scan the message for viruses whenever it was sent from an unknown system.”

- Note that is necessary to not one of common ways to express p -> q.

but whenever is.

**c)** *q* →*p*

Other solution

First step translate it to if p, then q.

“then scan the message for viruses, if it was sent from an unknown system.”

**d)** “When a message is not sent from an unknown system it is not scanned for viruses.”

**d)** ￢*q* →￢*p*

1. Determine whether each of these conditional statements is true or false.

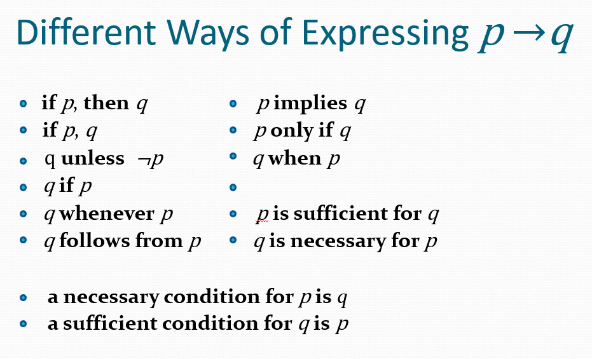
**a)** If 1 + 1 = 2, then 2 + 2 = 5.

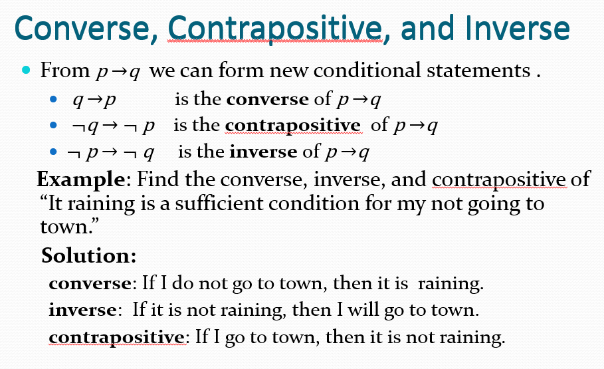
**b)** If 1 + 1 = 3, then 2 + 2 = 4.

**c)** If 1 + 1 = 3, then 2 + 2 = 5.

**d)** If monkeys can fly, then 1 + 1 = 3.

**a)** False **b)** True **c)** True **d)** True





1. State the converse, contrapositive, and inverse of each of these conditional statements.

**a)** If it snows tonight, then I will stay at home.

a) Converse: If I stay home, then it will snow tonight. Contrapositive: If I do not stay at home, then it will not snow tonight. Inverse: If it does not snow tonight, then I will not stay home.

**b)** I go to the beach whenever it is a sunny summer day.

b) Converse: Whenever I go to the beach, it is a sunny summer day. Contrapositive: Whenever I do not go to the beach, it is not a sunny summer day. Inverse: Whenever it is not a sunny day, I do not go to the beach.

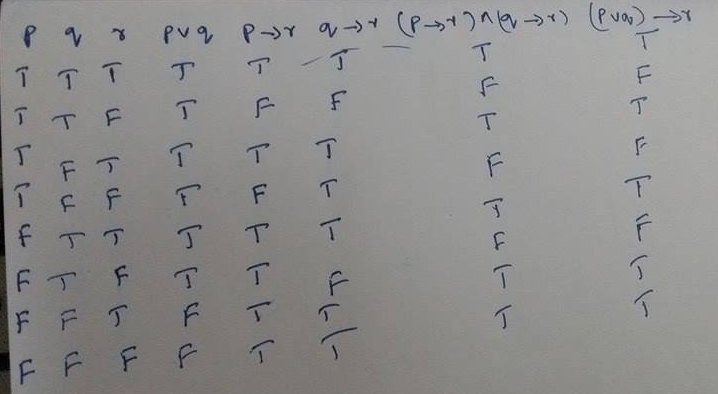
**c)** When I stay up late, it is necessary that I sleep until noon.

(can be past? Then need to have if,then)

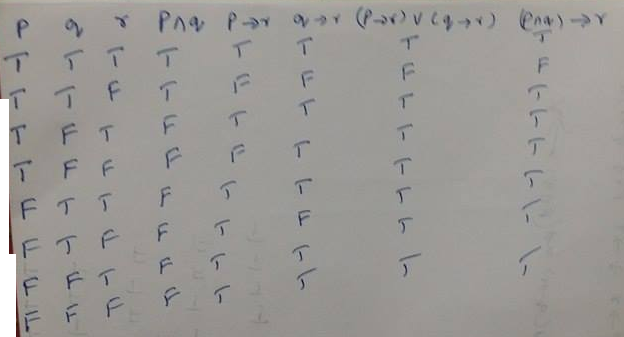
if I stay up late, then I sleep until noon.

c) Converse: If I sleep until noon, then I stayed up late. Contrapositive: If I do not sleep until noon, then I did not stay up late. Inverse: If I don’t stay up late, then I don’t sleep until noon.

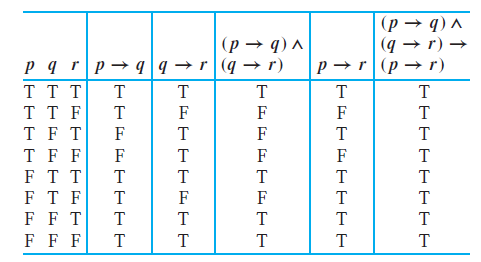
1. Show that *(p* → *r)* ∧ *(q* → *r)* and *(p* ∨ *q)* → *r* are logically equivalent using truth table.



1. Show that *(p* → *r)* ∨ *(q* → *r)* and *(p* ∧ *q)* → *r* are logically equivalent using truth table



1. Show that *(p* → *q)* ∧ *(q* → *r)* → *(p* → *r)* is a tautology using truth table



1. Use De Morgan’s laws to find the negation of each of the following statements.

**a)** Jan is rich and happy.

**a)** Jan is not rich, or Jan is not happy.

**b)** Carlos will bicycle or run tomorrow.

**b)** Carlos will not bicycle tomorrow, and Carlos will not run tomorrow.

**c)** ”If elephants can fly, then the Cubs will lose the World Series this year”

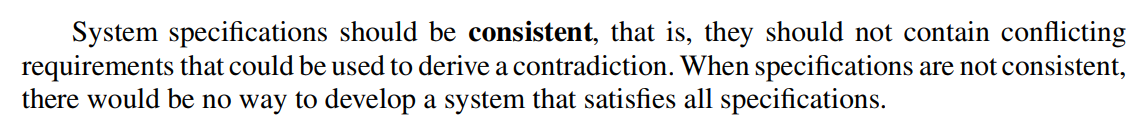
**c)** p -> q = -p V q

**Then –(-pVq) = p ^ -q**

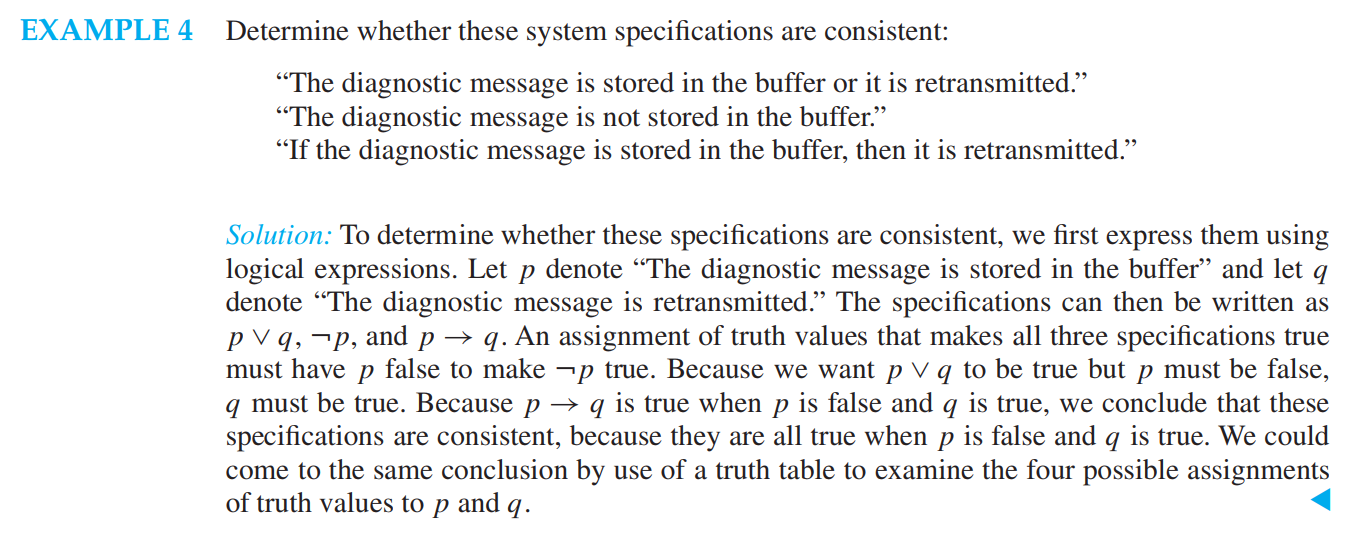
elephants can fly and the cubs will not lose the World Series this year.

**d)** if I am not hungry then it is not noon

**d)** I am not hungry and it is noon



Contradiction تناقض



To determine whether these specifications are consistent,

**First: Express them using logical expressions (extract propositions and then use them with logical connectives).**

Express these system specifications using the propositions together with logical connectives (including negations).

1. Are these system specifications consistent?
   1. “If the file system is not locked, then new messages will be queued.If the file system is not locked, then the system is functioning normally, and conversely. If new messages are not queued, then they will be sent to the message buffer. If the file system is not locked, then new messages will be sent to the message buffer. New messages will not be sent to the message buffer.”

L = file system locked,

Q = new messages are queued,

B = new messages are sent to the message buffer,

N = system functioning normally.

￢L→Q 1

￢*L* ↔N 2

￢Q→B 3

￢L→B 4

￢B 5

Case 1 (B is True): Then 5 is false, and the whole specification is false.

Case 2 (B is False): then 5 is true.

4 is true if L is true and B is false

3 is true if Q is true and B is false

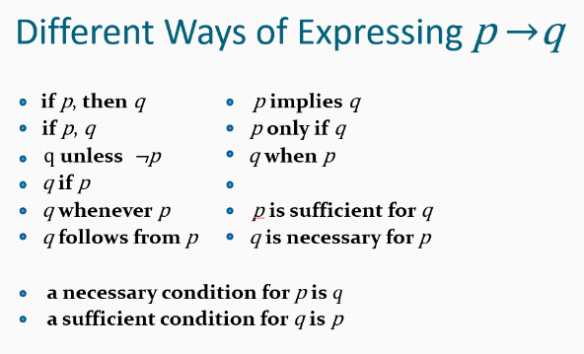
2 is true in N is false and L is true

1 is true as L is false and Q is true

A set of propositions is consistent if there is a possible situation in which they are all true

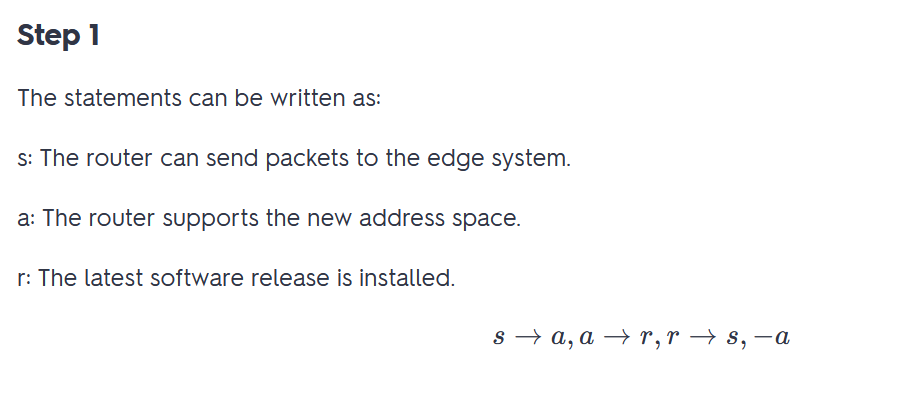
in case 2 all are true, therefore given specification are Consistent

[Q 12 in book e 7. Before 11 next one??]



* 1. “The router can send packets to the edge system only if it supports the new address space.”. “For the router to support the new address space it is necessary that the latest software release be installed.”. “The router can send packets to the edge system if the latest software release is installed”. “The router does not support the new address space.”

[Q 11 in book e 7.]

****

**صورة تحتوي على نص

تم إنشاء الوصف تلقائياً**

****

**consistent**

1. Determine whether the compound propositions are satisfiable.

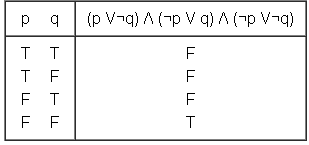
**a)** *(p* ∨￢*q)* ∧ *(*￢*p* ∨ *q)* ∧ *(*￢*p* ∨￢*q) let students solve it and give them the solution.*

**b)** *(p* → *q)* ∧ *(p* →￢*q)* ∧ *(*￢*p* → *q)* ∧ *(*￢*p* →￢*q)*

**c)** *(p* ↔ *q)* ∧ *(*￢*p* ↔ *q)*

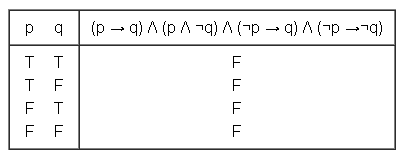
**Solution: A proposition is satisfiable if some setting of the variables makes the proposition**

**True or atleast one combination of the rows must be true. If we write the truth table for the above proposition**

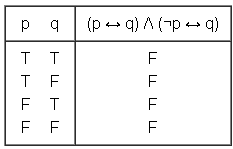
**a)**

**satisfiable**

**b)**

****

Not satisfiable

c) 

Not Satisfiable