Solutions to predicate Logic Tutorial 1

1.

a. term(logic,1)
b. ∀C (term(C,1)→compulsory(C))
c. ∃C (term(C,2)∧compulsory(C))
d. ∀C (term(C,2)→¬∃Yprereq(Y,C) ∨ (∃Yprereq(Y,C) ∧ ∀X(prereq(X,C)→term(X,1))))
e. ∀X,Y (term(X,2) ∧ prereq(Y,X) → term(Y,1))
f. ∀X (term(X,1) ∨ term(X,2) →∃Y(lecturer(Y) ∧ teaches(Y,X)))
g. ∃Y(lecturer(Y) ∧ ∀X (term(X,1) ∨ term(X,2) → teaches(Y,X)))

2.
Describing the gate types:

xorgate(g1)
This says g1 is an xor gate.
xorgate(g2)
andgate(g3)
andgate(g4)
orgate(g5)

Describing the inputs:

input1(g1,1)
input2(g1,0)
These say the first input of g1 is 1 and the second input of g1 is 0.

∀X (input1(g2,X)← output(g1,X))
This says the output of g1 is the first input of g2.
input2(g2,1)

input1(g3,1)
∀X (input2(g3,X) ← output(g1,X))
This says the output of g1 is the second input of g3.

input1(g4,1)
input2(g4,0)

∀X (input1(g5,X) ← output(g3,X))
∀X (input2(g5,X) ← output(g4,X))

Describing outputs of gates:

∀X,G,I1,I2 (output(G,X) ← andgate(G) ∧ input1(G,I1) ∧ input2(G,I2) ∧ and_result(I1, I2, X))
This says if G is an andgate and its two inputs are I1 and I2, then the output of G is the result of and-ing I1 and I2.

∀X,G,I1,I2 (output(G,X) ← orgate(G) ∧ input1(G,I1) ∧ input2(G,I2) ∧ or_result(I1, I2, X))
∀X,G,I1,I2 (output(G,X) ← xorgate(G) ∧ input1(G,I1) ∧ input2(G,I2) ∧ xor_result(I1, I2, X))

and_result(1,1,1)
∀X (and_result(0,X,0))
∀X (and_result(X,0,0))

or_result(0,0,0)
∀X (or_result(1,X,1))
∀X (or_result(X,1,1))

$\forall X$ (xor_result(X,X,0))
$\forall X,Y$ (xor_result(X,Y,1) $\leftarrow \neg X=Y$)