Question 1

a)

```
1<3
```

```
ans = logical
   1
```

b)

```
3<2
```

```
ans = logical
   0
```

c)

```
3<3
```

```
ans = logical
   0
```

d)

```
1<=3
```

```
ans = logical
   1
```

e)

```
3<=3
```

```
ans = logical
   1
```

f)

```
1>2
```

```
ans = logical
   0
```

g)

```
2>=2
```

```
ans = logical
   1
```

h)

```
14~=15
```

```
ans = logical
   1
```

i)

```
14~=14
```

```
ans = logical
   0
```

question 2

```
x = 12 % in the command window
```

```
x =
12
```

```
x == 13
```

```
ans = logical
   0
```

```
x==12
```

```
ans = logical
   1
```

```
x~= 13
```

```
ans = logical
   1
```

```
(x==12)|(x>3)
```

```
ans = logical
   1
```

```
(x==12)|(x<3)
```

```
ans = logical
   1
```

```
(x==12)&(x>3)
```

```
ans = logical
   1
```

```
~(x==12)|(x>3)
```

```
ans = logical
   1
```

```
~((x==12)|(x>3))
```

```
ans = logical
   0
```

Question 3

```
a=1
```

```
a =
1
```

```
b=true
```

```
b = logical
   1
```

```
c=0
```

```
c =
0
```

```
f=a&b % 1 / true
```

```
f = logical
   1
```

```
g=a|b&c % 1 true
```

```
g = logical
   1
```

```
h=xor(~a,c)
```

```
h = logical
   0
```

Question 4 (bit strings)

```
a = [1 0 0 1]
```

```
a = 1×4
     1     0     0     1
```

```
b = [0 1 0 1]
```

```
b = 1×4
     0     1     0     1
```

```
c = a & b
```

```
c = 1×4 logical array
   0   0   0   1
```

```
d = a | b
```

```
d = 1×4 logical array
   1   1   0   1
```

```
r = xor(a,b)
```

```
r = 1×4 logical array
   1   1   0   0
```

```
f = ~(a)
```

```
f = 1×4 logical array
   0   1   1   0
```

question 5 (XOR Truth Table)

```
n = 2;
A = dec2bin((2^n)-1:-1:0)-'0';
fprintf("        A       B       xor(A,B)")
```

```
        A       B       xor(A,B)
```

```
for i = 1 : (2^n)
    A(i,3)=xor(A(i,1),A(i,2));
end
A
```

```
A = 4×3
     1     1     0
     1     0     1
     0     1     1
     0     0     0
```

Question 6

```
n = 2;
A = dec2bin((2^n)-1:-1:0)-'0';
fprintf("        A       B       A->B")
```

```
        A       B       A->B
```

```
for i = 1 : (2^n)
    X = A(i,1);
    Y = A(i,2);
    Z = ~X | Y;
    A(i,3) = Z;
end
A
```

```
A = 4×3
     1     1     1
     1     0     0
     0     1     1
     0     0     1
```

Question 7

```
n = 2;
A = dec2bin((2^n)-1:-1:0)-'0';
fprintf("        A       B       A<->B")
```

```
        A       B       A<->B
```

```
for i = 1 : (2^n)
    X = A(i,1);
    Y = A(i,2);
    Z = ~xor(X,Y);
    A(i,3) = Z;
end
A
```

```
A = 4×3
     1     1     1
     1     0     0
     0     1     0
```

```
     0     0     1
```

Question 8

```
clear all;
n = 2;

A= dec2bin(2^n-1:-1:0)-'0';

for i = 1 : (2^n)
        % 3rd Col is P->Q
        if ( A(i, 1)==1 & A(i, 2)==0 );
        A(i, 3)= 0;
        else
        A(i,3)=1;
        end
        % 4th Col is (~P)+Q
       A(i, 4)=(~A(i, 1))|A(i, 2 );
        % XNOR(Col 3,Col 4) (Col3<->Col4)
       A(i, 5)=~(xor(A(i,3),A(i, 4)));
end

 ans = [A ]
```

```
ans = 4×5
     1     1     1     1     1
     1     0     0     0     1
     0     1     1     1     1
     0     0     1     1     1
```

```

if A (1:2^n,5)==ones(2 ^n, 1)
        fprintf('Tautology')
else
if A (1:2^n,5)==zeros(2^n, 1)
        fprintf('contradiction')
else
    fprintf('contingency')
end

end
```

```
Tautology
```

Question 9

```
% Re-run the previous code with n=3
clear all;
n = 3;

A= dec2bin(2^n-1:-1:0)-'0';

for i = 1 : (2^n)
```

```
        % 3rd Col is P->Q
        if ( A(i, 1)==1 & A(i, 2)==0 );
        A(i, 3)= 0;
        else
        A(i,3)=1;
        end
        % 4th Col is (~P)+Q
       A(i, 4)=(~A(i, 1))|A(i, 2 );
        % XNOR(Col 3,Col 4) (Col3<->Col4)
       A(i, 5)=~(xor(A(i,3),A(i, 4)));
end

 ans = [A ]
```

```
ans = 8×5
     1     1     1     1     1
     1     1     1     1     1
     1     0     0     0     1
     1     0     0     0     1
     0     1     1     1     1
     0     1     1     1     1
     0     0     1     1     1
     0     0     1     1     1
```

```
if A (1:2^n,5)==ones(2 ^n, 1)
        fprintf('Tautology')
else
if A (1:2^n,5)==zeros(2^n, 1)
        fprintf('contradiction')
else
    fprintf('contingency')
end

end
```

```
Tautology
```

Question 10

```
clear all;
n = 3;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
% 4th column is P->Q
A(i,4)= (~A(i, 1))|A(i,2);

% 5th col is P->R
A(i,5)= (~A(i, 1))|A(i,3);

% 6th col represent P->Q & P->R
A(i,6)= A(i, 4)&A(i,5);

% 7th col represent Q & R
A(i,7)= A(i, 2)&A(i,3);
```

```
% 8th col represent P->(Q & R)
A(i,8)= (~A(i, 1))|A(i,7);

end

ans=[A]
```

```
ans = 8×8
     1     1     1     1     1     1     1     1
     1     1     0     1     0     0     0     0
     1     0     1     0     1     0     0     0
     1     0     0     0     0     0     0     0
     0     1     1     1     1     1     1     1
     0     1     0     1     1     1     0     1
     0     0     1     1     1     1     0     1
     0     0     0     1     1     1     0     1
```

```
if A(1:2^n, 6)== A(1:2^n , 8)
    fprintf('yes, , the propositions are equivalent')
else
    fprintf('No, , the propositions are not equivalent')
end
```

```
yes, , the propositions are equivalent
```

Question 11

```
clear all;
n = 3;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
% 4th column is P->Q
A(i,4)= (~A(i, 1))|A(i,2);

% 5th col is P->R
A(i,5)= (~A(i, 1))|A(i,3);

% 6th col represent P->Q & P->R
A(i,6)= A(i, 4)&A(i,5);

% 7th col represent Q + R
A(i,7)= A(i, 2)|A(i,3);

% 8th col represent P->(Q + R)
A(i,8)= (~A(i, 1))|A(i,7);

end

ans=[A]
```

```
ans = 8×8
     1     1     1     1     1     1     1     1
     1     1     0     1     0     0     1     1
```

```
     1     0     1     0     1     0     1     1
     1     0     0     0     0     0     0     0
     0     1     1     1     1     1     1     1
     0     1     0     1     1     1     1     1
     0     0     1     1     1     1     1     1
     0     0     0     1     1     1     0     1
```

```
if A(1:2^n, 6)== A(1:2^n , 8)
    fprintf('yes, , the propositions are equivalent')
else
    fprintf('No, , the propositions are not equivalent')
end
```

```
No, , the propositions are not equivalent
```

Question 12

```
clear all;
n = 3;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
% 4th column is P+Q
A(i,4)= (A(i, 1))|A(i,2);

% 5th col is P->R
A(i,5)= (~A(i, 1))|A(i,3);

% 6th col is Q->R
A(i,6)= (~A(i, 2))|A(i,3);

% 7th col represent (P+Q)^(P->R)^(Q->R)
A(i,7)= A(i, 4)&A(i,5)&A(i,6);

% 8th col represent ((P+Q)^(P->R)^(Q->R))->R
A(i,8)= (~A(i, 7))|A(i,3);

end

ans=[A]
```

```
ans = 8×8
     1     1     1     1     1     1     1     1
     1     1     0     1     0     0     0     1
     1     0     1     1     1     1     1     1
     1     0     0     1     0     1     0     1
     0     1     1     1     1     1     1     1
     0     1     0     1     1     0     0     1
     0     0     1     0     1     1     0     1
     0     0     0     0     1     1     0     1
```

```
if A (1:2^n,8)==ones(2 ^n, 1)
        fprintf('Tautology')
else
if A (1:2^n,8)==zeros(2^n, 1)
        fprintf('contradiction')
```

```
else
    fprintf('contingency')
end

end
```

```
Tautology
```

Question 13

1)

```
clear all;
n = 3;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
% 4th column is P->Q
A(i,4)= (~A(i, 1))|A(i,2);

% 5th col is (P->Q)->R
A(i,5)= (~A(i, 4))|A(i,3);

% 6th col represent Q->R
A(i,6)= (~A(i, 2))|A(i,3);

% 7th col represent P->(Q->R)
A(i,7)= (~A(i, 1))|A(i,6);
end

ans=[A]
```

```
ans = 8×7
     1     1     1     1     1     1     1
     1     1     0     1     0     0     0
     1     0     1     0     1     1     1
     1     0     0     0     1     1     1
     0     1     1     1     1     1     1
     0     1     0     1     0     0     1
     0     0     1     1     1     1     1
     0     0     0     1     0     1     1
```

```
if A(1:2^n, 5)== A(1:2^n , 7)
    fprintf('yes, , the propositions are equivalent')
else
    fprintf('No, , the propositions are not equivalent')
end
```

```
No, , the propositions are not equivalent
```

2)

```
clear all;
n = 3;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
```

```
% 4th column is P^Q
A(i,4)= (A(i, 1))&A(i,2);

% 5th col is (P^Q)->R (LHS)
A(i,5)= (~A(i, 4))|A(i,3);

% 6th col represent P->R
A(i,6)= (~A(i, 1))|A(i,3);

% 7th col represent (Q->R)
A(i,7)= (~A(i, 2))|A(i,3);

% 8th col represent (P->R)^(Q->R) (RHS)
A(i,8)= A(i,6)&A(i,7);
end

ans=[A]
```

```
ans = 8×8
     1     1     1     1     1     1     1     1
     1     1     0     1     0     0     0     0
     1     0     1     0     1     1     1     1
     1     0     0     0     1     0     1     0
     0     1     1     0     1     1     1     1
     0     1     0     0     1     1     0     0
     0     0     1     0     1     1     1     1
     0     0     0     0     1     1     1     1
```

```
if A(1:2^n, 5)== A(1:2^n , 8)
    fprintf('yes, , the propositions are equivalent')
else
    fprintf('No, , the propositions are not equivalent')
end
```

```
No, , the propositions are not equivalent
```

3)

```
clear all;
n = 4;
A= dec2bin(2^n-1:-1:0)-'0';
for i=1 : 2^n
% 5th col represent P->Q
A(i,5)= (~A(i, 1))|A(i,2);
% 6th col represent R->S
A(i,6)= (~A(i, 3))|A(i,4);
% 7th col represent (P->Q)->(R->S) (LHS)
A(i,7)= (~A(i, 5))|A(i,6);
% 8th col represent P->R
A(i,8)= (~A(i, 1))|A(i,3);
% 9th col represent Q->S
A(i,9)= (~A(i, 2))|A(i,4);
% 10th col represent (P->R)->(Q->S) (RHS)
A(i,10)= (~A(i, 8))|A(i,9);
end
```

```
ans=[A]
```

```
ans = 16×10
     1     1     1     1     1     1     1     1     1     1
     1     1     1     0     1     0     0     1     0     0
     1     1     0     1     1     1     1     0     1     1
     1     1     0     0     1     1     1     0     0     1
     1     0     1     1     0     1     1     1     1     1
     1     0     1     0     0     0     1     1     1     1
     1     0     0     1     0     1     1     0     1     1
     1     0     0     0     0     1     1     0     1     1
     0     1     1     1     1     1     1     1     1     1
     0     1     1     0     1     0     0     1     0     0
     ⋮
```

```
if A(1:2^n, 7)== A(1:2^n , 10)
    fprintf('yes, , the propositions are equivalent')
else
    fprintf('No, , the propositions are not equivalent')
end
```

```
No, , the propositions are not equivalent
```