P7.

a) d(x,w) = 2 d(x,y) = 4 d(x,u) = 7

b) Shortest path: d(xwu) = 2+5 Other path: d(xyu) = 4+6

For x to inform new minimum path to u, either c(xw) ≥ 6 or c(xy) ≤ 1

Note that shortest path from x to y goes through route xw, so if we were to change c(xw), d(xyu) will also change accordingly until c(xw)+c(wy) is greater than c(xy). In case where the costs are the same, it's up to topology to decide which route to take, and even a new path is not established, the new cost will still be informed.

c) For x to not inform new minimum path to u, either c(xw) < 6 or c(xy) > 1

P8.

Node x table

from \ cost to	x	y	z
x	0	3	4
y	∞	∞	∞
z	∞	∞	∞

from \ cost to	x	y	z
x	0	3	4
y	3	0	6
z	4	6	0

Node y table

From \ cost to	x	y	z
x	∞	∞	∞
y	3	0	6
z	∞	∞	∞

from \ cost to	x	y	z
x	0	3	4
y	3	0	6
z	4	6	0

Node z table

from \ cost to	x	y	z
x	∞	∞	∞
y	∞	∞	∞
z	4	6	0

from \ cost to	x	y	z
x	0	3	4
y	3	0	6
z	4	6	0

P14.

a) eBGP 3c learns from 4c

b) iBGP 3a learns from 3c

c) eBGP 1c learns from 3a

d) iBGP 1d learns from 1c

P5.

<table>
<tr>
<td>G = 1001 D = 11000111010

11011100110
1001 | 11000111010000
1001
1010
1001
1111
1001
1101
1001
1000
1001
1100
1001
1010
1001
110

R = 110</td>
<td>G = 10011 D = 1010101010

1011011100
10011 | 10101010100000
10011
11001
10011
10100
10011
11110
10011
11010
10011
10010
10011
0100

R = 0100</td>
</tr>
</table>

P6.

G = 10011

a) D = 1001010101

```
           1000100000
10011 | 10010101010000
        10011
            11010
            10011
             10011
             10011
                  0000
```

R = 0000

b) D = 0101101010

```
           0101010101
10011 | 01011010100000
         10011
           10110
           10011
             10110
             10011
               10100
               10011
                 11100
                 10011
                  1111
```

R = 1111

c) D = 1010100000

```
           1011010111
10011 | 10101000000000
        10011
          11000
          10011
           10110
           10011
             10100
             10011
               11100
               10011
                11110
                10011
                 11010
                 10011
                  1001
```

R = 1001

G = 1001

a) D = 01101010101

```
          01100110011
1001 | 01101010101000
         1001
          1000
          1001
             1101
             1001
              1000
              1001
                 1100
                 1001
                  1010
                  1001
                   011
```

R = 011

b) D = 11111010101

```
          11100110011
1001 | 11111010101000
       1001
        1101
        1001
         1000
         1001
            1101
            1001
             1000
             1001
                1100
                1001
                 1010
                 1001
                  011
```

R = 011

c) D = 10001100001

```
          10011111110
1001 | 10001100001000
       1001
          1110
          1001
           1110
           1001
            1110
            1001
             1110
             1001
              1111
              1001
               1100
               1001
                1010
                1001
                 110
```

R = 110

P7.

a)

If we divide (D append R) by G, the result will be zero if there's no errors, so a linear relation. If a single bit error occurred, then the result of (D append R) divided by G won't be zero; therefore, we know that there's an error.

The degree of G is 3, which means consecutive bit errors of 3 and fewer bits will be detected.

b)

G = 1001 has even number of 1s and the smallest even number of 1s is $(11)_2$ excluding 0. Odd number bits errors are not divisible to $(11)_2$. As a result, all odd number bits errors are detected.

P8.

a)

Take the derivative and set it to 0

$f'(p) = N(1-p)^{N-1} - Np(N-1)(1-p)^{N-2} = 0$

$(1-p)^{N-1} = p(N-1)(1-p)^{N-2}$

$1 - p = p(N-1)$

$1 = p((N-1) + 1)$

$p = 1/N$

b)

$f(p) = N(1/N)(1-1/N)^{N-1} = (1-1/N)^{N-1} = (1-1/N)^{N} / (1-1/N)$

As N approaches infinity:

$(1-1/N)^{N} = 1/e$ and $(1-1/N) = 1$

Therefore, the efficiency of slotted ALOHA = **1/e** as N approaches infinity.

P15.

a)

No, E knows F is in the same LAN from IP address.

Source IP: E’s IP Destination IP: F’s IP

Source MAC: E’s MAC Destination MAC: F’s MAC

b)

No, E knows B is not in the same LAN from IP address.

Source IP: E’s IP Destination IP: B’s IP

Source MAC: E’s MAC Destination MAC: R1’s MAC facing subnet 3

c)

S1 will also broadcast the message because of the broadcast address in destination address, and learns that A is in subnet 1.

R1 also receives the message, but it doesn’t forwards it to subnet 3.

B doesn’t ask for A’s MAC address because it’s already included in A’s message.

S1 will add B into forwarding table and then drop the message because A and B are in the same LAN.