KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
COLLEGE OF COMPUTER SCIENCES & ENGINEERING
COMPUTER ENGINEERING DEPARTMENT
COE 540 – Computer Networks

Problem 1 (10 points):

Refer to discussion in textbook pages 166 and 167.

Problem 2 (20 points):

a) First bit of frame is received by earth station in Riyadh at t0 + tprop
where tprop is the propagation time for the signal
tprop = d / c = 2x36,000x1000/(3x10^8) = 0.24 sec
Note the distance is TWICE the satellite distance

b) The last bit departs the transmitter at t0 + tf
where tf is the frame transmission time
tf = 64x1024x8/1e6 = 0.5243 second

c) The last bit arrives at receiver at time t0 + tf + tprop = t0 + 0.7643

d) If the frame fails at the rate of p ➔ average number of times would be 1/p = 5 times.
Note the number of required transmissions follows a geometric distribution.

Problem 3 (10 points):

Refer to textbook pages 93 and 94.

Problem 4 (10 points):

```
 (a)
Size of frame =    199065600 bits     or       0.0232 Gbytes
     bit rate =   5971968000 bits/sec or       0.6952 Gbytes/sec
(b)
Size of single-layer blue ray disc is  25 Gbytes
Maximum movie length is   35.959 sec or    0.599 min
(c)
Size of 120 min video is 5005.646 Gbytes

1 byte  = 8 bits
1Kbytes = 1024
1Mbytes = 1024x1024 bytes
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```
1Gbytes = 1024x1024x1024 bytes
Size of single-layer blue ray disc = 25 Gbytes
```

Problem 5 (10 points):

```
>> A = [1 -1 1 -1];
>> B = [1 1 -1 -1];
>> C = [1 -1 -1 1];
>> -A+B+C

ans =

     1     1    -3     1

>> S = -A+B+C

S =

     1     1    -3     1
```

```
>> sum(S.*A)

ans =

    -4 ← A receives its correct 0 bit

>> sum(S.*B)

ans =

     4 ← B receives its correct +1 bit

>> sum(S.*C)

ans =

     4 ← C receives its correct +1 bit
```

Problem 6 (5 points):

For a signal at 2.4 GHz, the wavelength is 2.4x10^9/(3x10^8) = 12.5 cm. Therefore, any difference in path length will lead to phase difference at the received signal – if the difference in path length is exactly 12.5 cm or integer multiples of it, the phase difference will be 180 degree. Since typically the difference in path lengths is random, the phase differences are also random.

Problem 7 (5 points):

There are 256 channels in all, minus 6 for POTS and 2 for control, leaving 248 for data. If 3/4 of these are for downstream, that gives 186 channels for downstream. ADSL modulation is at 4000 baud, so with QAM-64 (6 bits/baud) we have 24,000 bps in each of the 186 channels. The total bandwidth is then 4.464 Mbps downstream.