KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
COLLEGE OF COMPUTER SCIENCES & ENGINEERING
COMPUTER ENGINEERING DEPARTMENT

COE 540 – Computer Networks
Assignment 1 – Due Date Sept 21st, 2014

Problem #	Maximum Mark	Mark
1	20	
2	20	
3	20	
4	10	
5	10	
6	10	
7	10	
Total	100	

Problem (1):

a) For the client-server model, all N peers must get all the F bits from the server. Therefore , we can note the following:

- The server must transmit one copy of the file to each of the N peers → Then D_{CS} must be $\geq \frac{NF}{u_s}$.
- Each of the N peers must download the file of F bits using its own download speed d_i for the i^{th} peer → D_{CS} must be $\geq \frac{F}{d_{\min}}$.

Combining the above two notes we obtain that $D_{CS} \geq \max\left\{\frac{NF}{u_s}, \frac{F}{d_{\min}}\right\}$.

b) For the P2P model, we can make the following notes:

- The server must send all the bits of the file of F bits at least once to the community of N peers → D_{P2P} must be $\geq \frac{F}{u_s}$.
- The i^{th} peer cannot get the file sooner than $\frac{F}{d_i}$ → D_{P2P} must be $\geq \frac{F}{d_{\min}}$.
- The model requires the F bits be transmitted by the server and then delivered to N peers. Therefore, the total number of bits transmitted is NF while the total upload capacity for the above configuration is given by $u_{\text{total}} = u_s + \sum_{i=1}^{N} u_i$ → D_{P2P} must be $\geq \frac{NF}{u_s+\sum_{i=1}^{N} u_i}$.

Combining the above three notes, one can write that $D_{P2P} \geq \max\left\{\frac{F}{u_s}, \frac{F}{d_{\min}}, \frac{NF}{u_s+\sum_{i=1}^{N} u_i}\right\}$.

Problem (2):

a) one can apply the formulas given in textbook or notes and utilize matlab to do the computations.

```
syms t A T n
pi = sym('pi');
assume(n, 'integer');

%s = 0; % for 0 <= t <T/8, 3*T/8 <= t < 6*T/8, and 7*T/8 <= t < T
%s = A;  % from T/8 <= t < 3T/8 and 6*T/8 <= t < 7*T/8
% the above determines the integral intervals

DC =1/T*(int(A, t, T/8, 3*T/8)     + int(A, t, 6*T/8, 7*T/8));
A0 = 2*DC;
An = collect(2/T*(int(A*cos(2*pi*n*t/T), t, T/8, 3*T/8) + int(A*cos(2*pi*n*t/T), t, 6*T/8, 7*T/8)));
Bn = collect(2/T*(int(A*sin(2*pi*n*t/T), t, T/8, 3*T/8) + int(A*sin(2*pi*n*t/T), t, 6*T/8, 7*T/8)));
CnRMS = matlabFunction(sqrt(An^2+Bn^2));
fprintf('A0 = \n'); pretty(A0);
fprintf('An = \n'); pretty(An);
fprintf('Bn = \n'); pretty(Bn);
```

```
>> FSE_TextbookExample_01

A0 =

  3 A
  ---
   4

An =

       / 3 pi n \         / 3 pi n \         / pi n \         / 7 pi n \
  A sin| ------ | - A sin| ------ | - A sin| ---- | + A sin| ------ |
       \   4    /         \   2    /         \  4   /         \   4    /
  -------------------------------------------------------------------
                                  pi n

Bn =

       / pi n \         / 3 pi n \         / 3 pi n \         / 7 pi n \
```

```
  A cos| ---- | + A cos| ------ | - A cos| ------ | - A cos| ------ |
       \  4   /        \   2    /        \   4    /        \   4    /
  ------------------------------------------------------------------
                                 pi n
>>
```

The main Matlab code and the correspond result are as shown above. The book results assume A = 1 volts.

b) The LPF will suppress all components with frequency equal or greater to $\frac{9}{T} = 9f_0$ Hz. Therefore, output signal corresponding to the first k harmonics is given by

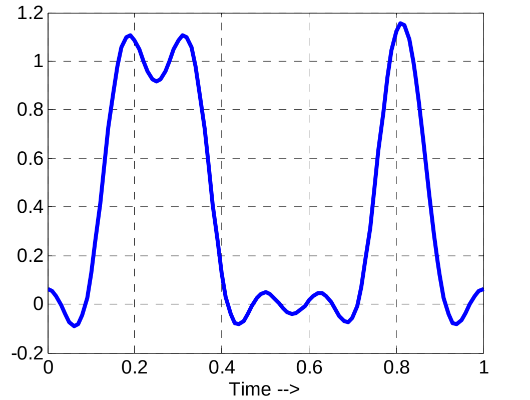
$$s_o(t) = \frac{3A}{4} + \sum_{n=1}^{k} A_n \cos(2\pi n f_0 t) + \sum_{n=1}^{k} B_n \sin(2\pi n f_0 t)$$

The power for $s_o(t)$ can be computed using

$$P_{s_o} = \left(\frac{A_0}{2}\right)^2 + \frac{1}{2}\sum_{n=1}^{k}(A_n^2 + B_n^2)$$

Using A = 1 and k=8, the expressions above evaluate to $P_{s_o} = 0.3504$ Watts.

The plot of $s_o(t)$ is as shown in Figure on the side (same as Figure 2-1 part e on textbook).




```
For A =     1 volts, T =     1 sec
Total power for s(t)       =   0.3750 Watts (DC
=   0.1406 plus AC =   0.2344)
power # of harmonics is 1   =   0.1703 Watts
power # of harmonics is 2   =   0.2970 Watts
power # of harmonics is 4   =   0.3288 Watts
power # of harmonics is 8   =   0.3504 Watts
power # of harmonics is 100 =   0.3730 Watts
```

c) BW is equal to 9 f0 = 9 Hz

Noise power, $N = B \times N_0 = 9 \times 10^{-3}$ Watts

Signal power, $S = 0.3504$ Watts (from part (b))

➔ $SNR = \frac{S}{N} = 38.933$ or 15.9 dB

➔ $C = B\log_2(1 + SNR) = 47.9$ b/s

Problem (3):

a) The F.T for the pulse $p(t)$ is given by:

$$P(f) = \int_{-\infty}^{\infty} p(t)e^{-2\pi jft}dt = \int_{-T/2}^{T/2} Ae^{-2\pi jft}dt = \frac{Ae^{-2\pi jft}}{-2\pi jf}\Bigg|_{t=-T/2}^{t=T/2}$$

$$= \frac{A}{\pi f} \times \frac{e^{\pi jfT} - e^{-\pi jfT}}{2j} = \frac{A}{\pi f}\sin(\pi fT) = AT\,\mathrm{sinc}(fT)$$

where $\mathrm{sinc}(x) = \sin(\pi x)/(\pi x)$ is the normalized sinc function.

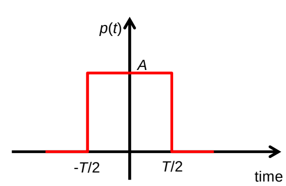


Figure 4: square pulse $p(t)$.

b) The plot for $|P(f)|^2$ is as shown in Figure. The function $|P(f)|^2$ has zeros for $f = \frac{n}{T}$ where n is an integer not equal to zero.

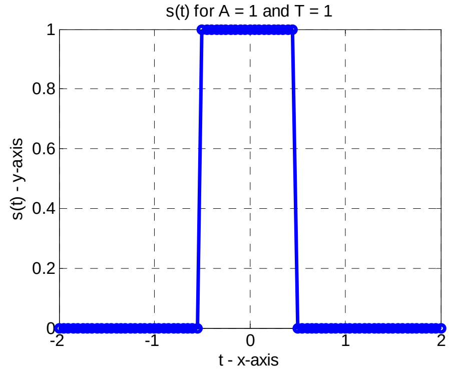


Figure A5.1: square pulse of width T (not required).

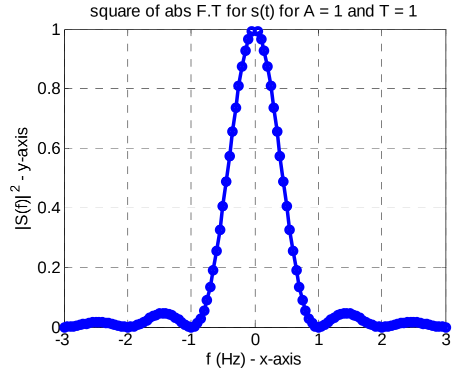


Figure A5.2: the square of F.T. for p(t).

c) The two limiting cases:

- As T → 0, the pulse approaches a delta function, $\delta(t)$, in the time domain. The corresponding frequency representation approaches a constant line. That is p(t) now contains all frequencies equally.
- As T → infinity, the pulse approaches a constant function in the time domain (i.e. a DC signal). The corresponding frequency representation approaches delta function, $\delta(f)$, where the spectrum is non zero only at (or very close to) f = 0 Hz.

Problem (4):

Refer to textbook pages 93 and 94.

Problem (5):

Refer to discussion in textbook pages 166 and 167.

Problem (6):

Item	**Pros**	**Cons**
Fixed payload size	Easy of processing (parsing)	Waste of bandwidth for unfilled payloads
Small payload size	Appropriate for real-time traffic (or delay/jitter sensitive traffic)	Waste for bandwidth when overhead fields are used

Problem (7):

```
>> Assign01_FHD_Problem
(a)
```

```
Size of frame =     49766400 bits     or       0.0058 Gbytes
     bit rate =   1492992000 bits/sec or       0.1738 Gbytes/sec
(b)
Size of single-layer blue ray disc is  25 Gbytes
Maximum movie length is  143.838 sec or    2.397 min
(c)
Size of 120 min video is 1251.411 Gbytes

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