UNIVERSITY OF CALIFORNIA, LOS ANGELES

*CS M117*

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**Home Work # 1** (Due 01/18/12)

(HW and solutions must be typed)

**Section A**

**(T, Chapter 1; pg. 1-54)**

**Communication Networks**

**1.** (2) What are two reasons for using layered protocols?

1. **If something needs to be changed in one layer, it will not effect on upper or lower level layers.**
2. **From the design standpoint, modularization makes it easy to maintain layers.**

2. (2) What is the principal difference between connectionless communication and connection-oriented communication?

**Connectionless communication is unidirectional which means that the data is sent without checking for destination, so it is unreliable. Also there is no handshake.**

**Connection-oriented communication is bidirectional and requires a handshake.**

3. Which of the OSI layers handles each of the following?

(a) (1) Dividing the transmitted bit stream into frames.

(b) (1) Determining which route through the subnet to use.

1. **Data link layer**
2. **Network layer**

4. (2) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers?

**If I consider network bandwidth = M + h\*n, then the fraction of the network bandwidth is filled with n\*h / (M + h\*n) headers.**

5. (2) List two ways in which the OSI reference model and the TCP/IP reference model are the same, now list two ways in which they differ.

**Similarities:**

1. **Their models are based on layered protocols.**
2. **They both have transport and application layers.**

**Differences:**

1. **Their reference models have different number of layers.**
2. **TCP/IP does not have session and presentation layers.**

* **1.**

         Both have a network, transport and application

**Section B**

Amplitude Modulation and Frequency Modulation

A rectangular waveform signal has a value of +*A* for some continuous interval during the period (the “mark”), and has a value of ‑*A* for the remainder of the period (the “space”). The “duty cycle” *d* of the rectangular wave is defined as the length of the positive interval divided by the period.

**1)** The effective amplitude spectrum of a signal is built from the RMS voltages of each frequency represented in the Fourier series for that signal.

**(a)** (1) If the amplitude of square wave signal is *Amax* = 4V, and frequency is *f* ; draw the effective amplitude spectra (through the 8th harmonic) for functions.

**(b)** (1) If the amplitude of sinusoidal wave signal is *Amax* = 4V and frequency is *f*; draw the effective amplitude spectra.



2). (2) The carrier signal *Sc*(*t*) = *Ac*cos( 2*fct* ) is amplitude modulated by a baseband square wave signal *Sm*(*t*) with amplitude *Am* = *Ac* (varies between +*Ac* and ‑*Ac*) and frequency *fm*. Write the Fourier series for the modulated signals *S*(*t*), for DSBTC AM (where the baseband DC offset is equal to +*Ac*) and DSBSC AM. Include the AM constructional coefficient KAM.

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| **DSBTC**  S(t)=(Ac/Kam)\*[Ac+(4Am/ π )\*(cos(2πfmt) - (1/3)\* cos(6πfmt) + (1/5)\* cos(10πfmt) - (1/7)\*cos(14πfmt)…)]\* cos(2πfct) |
| **DSBSC**  S(t)=(Ac/Kam)\*(4Am/ π )\*[(cos(2πfmt) - (1/3)\* cos(6πfmt) + (1/5)\* cos(10πfmt) - (1/7)\*cos(14πfmt)…)] \*cos(2πfct) |

3) (1) Write the formula (using Bessel functions) for the frequency modulated signal when the baseband signal is *Sm*(*t*) = *Am*sin( 2*fmt* ) and the carrier modulated signal is:



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| S(t)=Ac\*cos(2πfct + -∞∫­t k\*Am(2πfmξ)dξ= Ac\*cos(2πfct + kf\*cos(2πfmt)];  where kf=(k\*Am)/( 2π\*fm) |

4) (2) Write the formula for the frequency modulation index *kf* with baseband signal *Sm*(*t*) = *Am*cos( 2*fmt* ), and calculate *kf* when *Am* = 4V, *fm* = 1000 Hz and KFM = 2** x 340.

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| kf=(k\*Am)/( 2π\*fm)=(340\*4/1000)=1.36 |

5) (2) Using the formula obtained in question (3) above and the Bessel function table given in the course reader, calculate and plot the power spectrum (amplitudes and frequencies) for the frequency modulated signal with a sinusoidal carrier signal (*Ac* = 4V and *fc* = 25 kHz) and a sinusoidal baseband signal (*Am* = 3V and *fm* = 1000 Hz). Assume the generator has FM constructional coefficient KFM = 2** x 340. Use these figures as the theoretical prediction in Part D of the experiment.



6) (1) What is a useful approximation for the bandwidth of an FM signal in terms of *kf* and the bandwidth of the baseband signal?

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| Bt = 2B\*(kf + 1) |