UNIVERSITY OF CALIFORNIA, LOS ANGELES

*CS M117*

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**Home Work # 1**

**Section A**

**Communication Networks**

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

1. **Modularization makes it easy to understand and maintain layers.**
2. **If one layer or a portion of a layer is updated, the whole protocol stack does not have to be changed as long as we maintain the interfaces between the layers.**

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

**During a connectionless communication there is no handshaking performed and the connection is unreliable.**

**During connection-oriented communication a handshake is done every time a connection has started and the communication is reliable, but carries more overhead.**

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.

**a-> Data Link layer**

**b-> 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?

**The length of a packet at the physical layer will be M+n\*h. The fraction of the network bandwidth that is filled with headers is: n\*h/(M+n\*h).**

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.

**Section B**

**Similarities:**

**They are both based on layered protocol.**

**They both have Network and Transport layers.**

**Differences:**

**They have different number of layers: OSI -> 7 and TCP/IP -> 4.**

**TCP/IP model doesn’t have Session and Presentation layers, but the OSI model does.**

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?

